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ABSTRACT

The document is the second of a series, to be integrated with a G.E.D. program, containing instructional materials at the basic skills level for the construction cluster. The volume focuses on masonry and consists of 20 instructional units which require a month of study. The units include: (1) historical aspects of masonry work and occupational information; (2) materials used; (3) masonry tools and equipment; (4) basic blueprint reading; (5) forming and pouring concrete footings; (6) concrete masonry typical construction practices; (7) bricklaying; (8) basic brick bonds; (9) rowlock, soldier, and lintelwork; (10) brick veneer work; (11) practice in laying the 8" American bond wall; (12) scaffold erection and construction; (13) and (14) special bonds used in bricklaying; (15) construction of brick and concrete block piers, pilasters, and chases; (16) building arches; (17) cleaning, treating, and painting masonry work; (18) constructing chimneys; (19) constructing foundations, trimmer arches, and hearths for fireplaces; and (20) fireplace work. Each unit includes the following information for the teacher: aim, instructional aids, equipment, primary references, introduction and motivation, a presentation of integrated concepts, application, evaluation criteria guidelines, summary, suggested time and sequence listing, and supplemental references and resource materials. A bibliography is included. (EC)

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VOCATIONAL EDUCATION PROGRAM OF STUDIES

Elementary, Secondary Education Act
Title I

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CONSTRUCTION CLUSTER
VOLUME II

CE006819

January 1, 1971
Pennsylvania Bureau of Correction

Harry A. Snyder
Director of Education

INTRODUCTION

The following information comprises one of seven volumes of instructional materials developed around a cluster of Construction Industries and Occupations. These instructional materials are primarily technical in focus but are written to be used in a cluster concept program as part of an integrated curriculum.

The materials are aimed at preparing students with basic skills necessary to enter a number of occupations in industries within the Construction cluster rather than providing an in-depth development of skill in any one occupation.

Each volume contains approximately one hundred twenty hours of instruction (about one month of study) and consists of twenty instructional units each having one or more specific lessons. Each unit is designed for six hours of instruction (three hours of technical laboratory experiences and three hours of related study in science, mathematics, communications and social studies) but may be varied at the instructor's discretion.

The seven volumes or cluster areas in the series are:

Volume I - Wood Structural Framing
II - Masonry Work
III - Plumbing
IV - Concrete Work
V - Electrical
VI - Air Conditioning and Refrigeration
VII - Heating and Ventilation

Students in the Construction cluster should be introduced to the technical and integrated content through several methods closely related to the industrial structure. Among these are line production and assembly, group projects, experimentation, unit studies and independent study. Team teaching techniques should be employed between the academic specialist and the technical specialist and coordinators.

It is recommended that an orientation program be offered students to familiarize them with the cluster areas available so they may select one they wish to pursue. The cluster instruction is designed to integrate with the regular G. E. D. program so students may receive an employable level of skill and a general academic background simultaneously.

As students select the technical cluster areas they wish to study, they should have the option to move through the G. E. D. content at their own speed using programed instructional materials, instructional television, computer assisted instruction and other individualized learning techniques. Technical and integrated concepts are introduced each day by the specialists involved.

After completion of one or more months of work within one cluster, a student could elect to study within another cluster providing, of course, this transfer is agreeable with the counselors, coordinators and instructors involved.

Lessons have been identified in the units. In most cases, however, there is only one lesson since each unit is limited to one day or six hours of instruction. The units offer the instructor the essential materials, vis-a-vis the aims, instructional aids, topical outline and activities, suggested time sequence, evaluation guidelines, summary and references. The primary and supplemental references are directly related to the topics and are important to the instructors. A selected bibliography is attached at the end of each volume as recommended additional sources of information.

Pagination of the units in this volume has been identified by cluster (C), volume (I, II, etc.), unit (1, 2, etc.) and page (.1, .2, .3, etc.) within each unit.

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18 Constructing Chimneys C-II-18.1

19 Constructing Foundations, Trimmer Arches, and Hearths for Fireplaces C-II-19.1

20 Fireplace Work C-II-20.1

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INSTRUCTOR'S UNIT PLAN

Unit 1
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Historical Aspects of Masonry Work and Occupational Information

AIM:

To develop a historical perspective of masonry work and the importance of masonry work in building construction. Also to develop insights about occupational and job advancement potential.

INSTRUCTIONAL AIDS:

Film - Clay and Craftsmanship, Washington, D. C.: Bricklayers, Masons and Plasterers International Union of America, Film Office, 815 Fifteenth Street N. W. (26 minutes, 16 mm, sound, color).

Film - Bricklayers, East Lansing, Michigan: Educational Film Library, Michigan State University (14 minutes, 16 mm, sound).

Posters - Various teacher-mounted pictures of famous ancient structures using masonry products.

EQUIPMENT:

16 mm movie projector, screen.

PRIMARY REFERENCES:

1) Dictionary of Occupational Titles, Volume 1--Definitions of Titles, Washington, D. C.: U. S. Government Printing Office, Latest Issue.

2) Occupational Outlook Handbook, Washington, D. C.: U. S. Government Printing Office, Latest Issue.

3) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Ask students for their opinion of the date of the earliest use of masonry. From this point lead into the film Clay and Craftsmanship. Continue with discussion on occupations in the masonry trades--past and present.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Early uses of masonry.	1. Early uses of masonry to develop an appreciation of the craft. a. Materials used b. Methods used 2. Examples: a. Nineveh b. Babylon c. Great Wall of China 3. Durability of masonry. a. Roman brick walls b. Cathedral of Chartes c. Cathedral of Rheims d. Temple of Heaven in Peking	1. Study of the composition of early bricks. a. The clay body b. Baking or firing of the clay bricks c. Types of mortar used 2. Discuss methods of identifying the age of ancient materials.
B. Beginning of Bricklayers Union.	1. Organizations used to train masons and control work quality.	
C. Unions and the construction industry.	1. Develop a factual concept of the role of unions in the present day construction industry.	
D. Occupations in the masonry trades.	1. Develop concept of various jobs, their work requirements, and pay scale. a. Laborer b. Mason helper c. Concrete block mason d. Brick mason e. Etc. 2. Physical requirements of masonry worker. a. Must like outdoor work b. Must be relatively strong c. Vigorous d. Not be afraid to work at some height 3. Conditions of work. a. Outdoors 1) Hot in summer 2) Cold in winter 3) Pleasant other times b. Somewhat dirty c. Hands may become "sore" from rough masonry units and mortar	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Use a time line to develop the concept of the age of masonry uses. a. Develop knowledge of B.C. and A.D. b. Develop concept of centuries--calendar development, etc.	1. Research some old building, brickmaking methodology, or other aspect of ancient masonry technology and write a report of same.	1. Discuss Biblical references to uses of brick and masonry materials. a. Examine the methods used to construct large buildings b. Discuss the importance of masonry--the great fire of London in 1666
		1. Beginnings of the craft guilds as the foundations of unions. a. Structures of the guilds b. Apprenticeship conditions c. Controlling characteristics
	1. Write to the Bricklayers, Masons, and Plasterers International Union of America to find apprenticeship requirements and employment conditions.	1. Discuss the labor movement in United States. 2. Explore wages, dues and other aspects of unionization. 3. Discuss employment without being a member of a union.
1. Compute wages earned at various total hours and various pay scales. 2. Compute deductions for various purposes.		1. Discuss development of division of labor. 2. Develop concept of increase in productivity by an increase in skill.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
	4. Rewards. a. Good wages b. Pride in building good solid buildings which will last	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Introduce lesson and elicit discussion on use of masonry materials in ancient structures.

B. Show film Clay and Craftsmanship.

C. Show film Bricklayers from the Americans-at-Work Series.

D. Have bricklayer or foreman from masonry firm discuss working conditions or take field trip to construction site.

E. Have union representative discuss aspects of unionization.

F. Discuss occupational opportunities, pay scales, working conditions.

IV. EVALUATION CRITERIA GUIDELINE

A. Discuss some of the early buildings which were erected of masonry.

B. What physical requirements are necessary for a bricklayer?

C. What is the employment potential in the masonry trades?

D. What is the role of unions in the construction industry?

E. Discuss craftsmanship as it relates to brick or block masonry.

V. SUMMARY

A. Bricks of various types have been used for construction for centuries and excavations by archeologists have discovered sun dried bricks in use 6,000 years ago. After the great fire in London in 1666, bricks became the main building medium in large cities. The brick and masonry trades segment of the construction industry is large and offers employment opportunities to large numbers of workers. The brick or block mason must be well-prepared in his trade and capable of doing rapid, high quality work.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

30 minutes -- Show film Clay and Craftsmanship

30 minutes -- Introduce and show film Bricklayers

30 minutes -- Discuss films and history of masonry

120 minutes -- Talk by masonry worker, union representative and discussion about working conditions

90 minutes -- Integrated curriculum concepts

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 1, Indianapolis: Theodore Audel, 1970.

INSTRUCTOR'S UNIT PLAN

Unit 2
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Materials Used--Bricks, Blocks, Structural Tile, and Mortar Materials

AIM:

To acquaint students with the various types of bricks, blocks, structural tile, and stone used in masonry work. Also to teach the correct preparation of mortar for masonry work.

INSTRUCTIONAL AIDS:

Film - Concepts in Clay, Washington, D. C.: Bricklayers, Masons and Plasterers International Union of America, Film Office, 815 Fifteenth Street N. W. (23 minutes, 16 mm, sound, color).

Transparencies - Brick Shapes BSM4, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

Samples - Teacher-collected samples of as many shapes, styles, and types of bricks, concrete blocks, and structural tile as can be assembled. Representative samples of stone should also be available.

EQUIPMENT:

16 mm projector, overhead projector, screen.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Concrete Block Construction for Home and Farm, Chicago: American Technical Society, 1970.

2) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

3) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Have examples of various masonry units displayed and utilize interest in these units to provide lead into film Concepts in Clay which shows structures utilizing various style and shaped masonry units. Proceed with lesson to familiarize students with types of masonry units available.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Bricks.	1. Clay and shale bricks. a. Types of clays used b. Types of shale used 2. Methods of producing bricks. a. Soft mud process b. Stiff mud process c. Dry press method 3. Curing and burning bricks. a. Drying b. Firing 1) Kiln types--beehive 2) Tunnel kilns 4. Colors and textures of bricks. a. Many colors available from white to black b. Textures--many textures are available 1) Smooth face 2) Sand face 3) Bark face 4) Matt face 5) Rug face 6) Scored face 7) Firebrick c. Bricks are either face or common clay 5. Sizes and shapes. a. Base size is 2-1/4" thick, 3-3/4" wide, 8" long b. Molding draft or taper on brick thickness c. Shapes of bricks 1) Stretcher 2) Header 3) Quoin 4) Closers--Queen-King 5) Bullnose--flat, double 6) Octagons 7) SCR bricks	1. The properties of a clay body. 2. Minerals and oxides used to color clay bodies. a. Mix a glaze b. Fire glaze to obtain color 3. Weight of bricks and water absorption of various types.
B. Concrete blocks.	1. Materials used: a. Cement b. Sand c. Gravel or crushed stone d. Water 2. Methods of producing concrete blocks. a. Dry process b. Wet process c. Pressure process 3. Curing process. a. Air dry in shade b. Steam curing 4. Types of concrete blocks. a. Various face textures available b. Can be colored c. Regular concrete units d. Lightweight concrete units	1. Methods of producing cement. 2. The principles of calcination. 3. The effect of steam on concrete as a curing medium.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Develop knowledge of ratios. 2. Develop ability to add whole numbers.	1. Research brick, clays, or methods of producing bricks and present oral report to class. a. Emphasize correctness of facts b. Logical development c. Interest and method of presentation 2. Develop vocabulary related to brick types and textures.	1. Discuss the impact and necessity for masonry construction in terms of developing large cities. 2. Discuss immigration patterns in terms of workers in the construction trades in the latter 19th and early 20th centuries. 3. Develop principles of mass production. a. Handmade bricks b. Semimachine methods c. Machine methods
1. Methods of proportioning materials--build concepts of weight, volume. 2. Weight/moisture content relationship problems. 3. Concept of modular components.	1. Develop ability to write letters of inquiry relative to product information. 2. Read text material for understanding--place emphasis on translating the written directions into action. 3. Build vocabulary related to concrete blocks.	1. Explore the idea of change from stone foundations to concrete block. Build the concept of utilization of technology for better living standards. 2. Discuss modular components and savings in labor, material, and construction time.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	5. Sizes and shapes. a. Stretcher b. Corner c. Double corner or pier d. Header e. Solid f. Beam or lintel g. Partition h. Bullnose i. Brick j. Sizes--base size - 7-5/8" wide, 7-5/8" high, 15-5/8" long k. Other sizes are usually nominal dimension less 3/8" for mortar joint	
C. Structural or hollow tile.	1. Materials used. a. Raw clay b. Sawdust, straw c. Water 2. Processes used for manufacture. a. Wet process b. Dry process c. Firing to intense heat--heat of vitrification 3. Types. a. Porous terra-cotta b. Hard or dense tile c. Load bearing d. Nonload bearing 4. Sizes and shapes. a. End construction tile b. Side construction tile c. Common tile units 1) Size of end construction tile--3-3/4" wide, 7-3/4" high, 12" long 2) Size of side construction tile--3-3/4" wide, 7-3/4" high, 12" long 3) Partition tiles 4) Backup units 5) Corner closure units 6) Jamb units 7) "T" units 8) Arch units 9) Etc.	1. Develop the concept of heat necessary for vitrification. 2. Develop knowledge of glazes and surface treatment of tile. 3. Develop concept of strength of materials.
D. Stone.	1. Types. a. Limestones b. Sandstones c. Granite d. Slate 2. Processing methods. a. Quarried b. Spit or guillotine cut c. Sawn	1. Develop concept of: a. Metamorphic rock b. Igneous rocks c. Sedimentary rocks 2. Develop concept of: a. Siliceous stones b. Agrillaceous stones c. Calcareous stones

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Build ability to multiply whole numbers. 2. Compute simple areas using multiplication--compute structural tile needed to construct the area.	1. Read and interpret product information literature. 2. Develop ability to read and understand building code regulations. 3. Build vocabulary relating to structural tile.	1. Develop concept of fireproofing buildings. a. Steel construction b. Curtain wall construction c. Role of masonry in protecting structural steel from fire damage 2. Study fire codes and building codes.
1. Develop concept of quantity of stone in a ton.		1. The importance of physical attributes of the area in terms of initial use of building materials. a. Climate factors b. Available wood c. Available clays d. Available stone

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	3. Sizes and shapes. a. Can be obtained in many sizes which are guillotine cut or sawn b. Most stone is in random size because of quarrying methods c. Stone is usually sized and shaped on the site	
E. Mortar.	1. Lime. a. Types b. Properties it imparts to mortar 1) Water retentivity 2) Plasticity c. Methods of preparing for use 2. Cement. a. Types 1) Portland 2) Portland-Pozzolana 3) Masonry cements 3. Aggregates. a. Types b. Properties c. Particle size 4. Water--water used must be clean and free from organic materials. 5. Proportions. a. Type A mortar--by volume--1 part portland cement, 1/4 part lime, 3 parts sand b. Type B mortar--by volume--1 part portland cement, 1 part lime, 6 parts sand c. Type C mortar--by volume--1 part portland cement, 2 parts lime, 9 parts sand or 1 part masonry cement, 3 parts sand	1. Types of lime and the properties of lime. 2. Properties of a cement material--principles of compounds, mixtures, and solutions. 3. Concept of specific gravity and weight of materials.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Build ability to subtract whole numbers. 2. Reinforce concept of volume/weight relationships. 3. Reinforce the concept of ratios and proportions as it applies to mortar mixes.	1. Writing specifications for cements--refer to ASTM Standard Specifications. 2. Reading packaging information and directions for commercial mortar mixes.	1. History of the cement industry--uses of cement by: a. Assyrians b. Egyptians--pyramids c. Romans 2. John Smeaton's discovery concerning burned limestone. 3. Joseph Aspdin and the patent for portland cement. 4. Jobs created by the cement industry.

III. APPLICATION

A. Introduce and show film Concepts in Clay.

B. Present information on bricks and have students identify the various bricks on display.

C. Present information on concrete blocks, structural tile and stone, and have students identify various units.

D. Present information on mortar mixes and have students experiment with small quantity mixes.

E. Integrate science and math concepts.

EVALUATION CRITERIA GUIDELINE

A. Have students identify lightweight and common concrete block.

B. Be sure students can identify masonry units as to type, size, and manufacture.

C. Have students compute quantities required for a given mortar mix.

D. Have students discuss appropriate materials to use for a particular job.

V. SUMMARY

A. Each craftsman should be familiar with the properties, capabilities, and limitations of the materials he uses. Therefore, it is important that he study materials and be able to identify them and properly apply them. Bricks, concrete blocks, and structural units come in many styles and shapes; hence, effort must be made to learn them.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduce lesson; show film Concepts in Clay

150 minutes -- Presentation and experience with various masonry units

75 minutes -- Integrated curriculum concepts

60 minutes -- Experiments with mortar mixes

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Day, Richard, The New Concrete and Masonry Guide, Greenwich, Conn.: Fawcett Publications, Inc., 1966.

2) Fishburn, Cyrus C., Effect of Mortar Properties on Strength of Masonry, Washington, D. C.: U. S. Department of Commerce, National Bureau of Standards, 1961.

3) Smith, Clyde P., The Manufacture of Brick, Tile, and Kindred Products, Washington, D. C.: U. S. Department of Labor, National Bureau of Standards, 1956.

INSTRUCTOR'S UNIT PLAN

Unit 3
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Masonry Tools and Equipment

AIM:

To familiarize students with tools and equipment used by brick, block, and stone masons.

INSTRUCTIONAL AIDS:

Slides - Teacher-made slides of various mason tools to enable showing a wide variety and also aid in identification. Have slides showing use.

Transparencies - Masonry Tools BSM1, Levels and Measuring Tools BSM2, Line Blocks and Plumb Bobs BSM3, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

Pass Out - Copy of Goldblatt Trowel Trades Tool Catalog, Kansas City: Goldblatt Tool Company, 511 Osage Street.

EQUIPMENT:

35 mm projector, overhead projector, screen.

Various types of trowels, both new and worn, also levels, hammers, chisels, line blocks, and other tools used by brick, block, and stone masons.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 1, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Have on display tools used in masonry working. After permitting students to examine tools, present slides showing uses of tools. Have worn, but well cared for, tools available and also worn and improperly maintained tools. Point out differences in tool weight, temper, and working quality.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Mortar mixing equipment.	1. Mortar box. a. Steel boxes of various sizes. b. On-job constructed wood boxes. 2. Power mixers. a. Rubber blade muller mixers b. Lime mixers 3. Hand tools. a. Mortar hoe b. Squarepoint shovel 4. Water barrel. a. Water source b. Storage place for shovels, hoes, etc. c. Galvanized pail for carrying water or mortar d. Rubber pails 5. Tool care. a. Tools should be thoroughly scraped and washed after use	1. Principles involved in the mixing process. a. Mechanical aspects b. Chemical processes
B. Mortar transporting equipment.	1. Mortar hod. 2. Wheelbarrows. 3. Mortar tubs for hoists.	1. Mechanical advantage gained by leverage. a. 1st class levers b. 2nd class levers c. 3rd class levers
C. Brick trowels--types and usage.	1. Trowel materials. a. High quality tempered steel b. Best quality is totally forged c. Handle of hardwood with a steel ferrule 2. Types of trowels. a. Narrow heel London b. Wide heel London c. Philadelphia pattern 3. Selection of trowels. a. High quality steel fully forged b. Flexible blade, yet stiff c. Heft and weight of trowel d. Handle comfort 4. Using the trowel. a. Correct method of holding trowel b. Picking up mortar c. Throwing mortar d. Spreading mortar e. Cutting off f. Buttering g. Jointing	1. Build the concept of what makes a quality steel. a. Composition b. Hardening c. Tempering

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Introduce measurement and volume in terms of capacity of on-site constructed mortar box.	1. Reading specifications about tools and power mixing equipment. a. Read for understanding b. Develop ability to compare equipment on basis of literature	1. Labor saving devices and their impact on productivity. a. Hand mixing of mortar and carrying of mortar and bricks to all levels of construction b. Transition to power mixers and use of hoists and elevators to transport materials
1. Computing simple problems of mechanical advantage.	1. Develop vocabulary relating to masonry tools. a. Trowels b. Scrutch c. Mash hammer d. Tuck pointer e. Raker f. Jointer g. Runner-sled h. Etc.	

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
D. General tools.	1. Pointing trowels. a. Tuck pointer b. Regular c. Long and short pointing d. Margin e. Round end 2. Brick hammers. a. Standard b. Short head--plain and toothed c. Mash hammer d. Stone hammers e. Weights of hammers f. Type and quality of steel and hardness g. Scrutch hammers h. Use of each tool 3. Jointers a. Concave b. Flat c. Vee d. Raker jointer e. Skate wheel jointer f. Sled runners g. Use of each tool 4. Lines and line blocks. a. Types of lines b. Corner blocks c. Line holders d. Line stretchers e. Uses 5. Brick mason's rules, spacing rules, and tapes. a. Materials b. Uses 6. Story poles. a. On-site constructed b. Aluminum c. Adjustable clip d. Uses and layout	1. Add to earlier concepts of stone structure by identifying principles of cleavage lines. a. Apply the above to stone b. Apply fracture concepts to cutting or breaking bricks and concrete blocks
E. Levels and squares.	1. Develop concept of level and plumb. 2. Levels. a. Material types and construction b. Suitable lengths c. Use and care of level 3. Squares. a. Steel carpenter's square b. Combination square	1. Develop concept of earth's center as it relates to the concept of plumb.

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Continue developing the ability to measure. a. Measure lengths b. Measure length of brick or block to fit a given space	1. Write letters requesting catalogs or information of a technical nature. 2. Read material about steel and steelmaking. a. Develop understanding of the process b. Develop knowledge of steel best suited for mason tools	1. Introduce subject of consumer protection. a. Discuss need for reading and understanding guarantees b. Review catalog descriptions. 2. Discuss federal and state legislation relating to consumer protection.
1. Develop knowledge of tangent as it relates to level and plumb. 2. Develop concept of square as it relates to squares, rectangles, cubes, etc.		

III. APPLICATION

A. Use transparencies and slides to present basic tools and tool nomenclature.

B. Present tools which are on display--show new and worn tools.

C. Show correct way to hold and use the brick mason's trowel.

D. Demonstrate use of other tools.

E. Develop concepts of level and plumb.

IV. EVALUATION CRITERIA GUIDELINE

A. Have students demonstrate correct method to hold a trowel.

B. What are the important characteristics of a good brick trowel?

C. Have students explain how to clean and care for the trowel.

D. Explain how to use the level.

E. Have students demonstrate use of the blocking chisel.

F. Have students lay out and explain the use of the story pole.

V. SUMMARY

A. Tools play a very important role in the worker's ability to do a quality job. Therefore, it is important that trainees know how to select quality tools and also how to use them. The mason must also know how to correctly care for his tools so that they will perform properly.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

45 minutes -- Presenting mixing and transporting tools

75 minutes -- Trowels and general tool presentation

60 minutes -- Practical application of throwing mortar on 2" x 4" practice blocks

60 minutes -- Integrated curriculum concepts

60 minutes -- Use of levels, lines, and squares

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Nash, William G., Brickwork One, New York: Drake Publications, 1971.

2) Ray, Jesse E., The Art of Bricklaying, Peoria, Ill.: Charles A. Bennett Company, Inc., 1971, 3rd Edition.

INSTRUCTOR'S UNIT PLAN

Unit 4
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Basic Blueprint Reading

AIM:

To present principles of orthographic projection and the use of various architectural symbols related to masonry construction. Also, basic architectural plans and sections should be interpreted.

INSTRUCTIONAL AIDS:

Transparencies - Building Site BC-1, Building Layout BC-4, Footing and Excavation BC-5, Foundation BC-6, Wall Section BC-7, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

Transparencies - Teacher-made of piers, fireplaces, brick veneer, and other applicable architectural details.

Plans - Representative architectural drawings of buildings from simple to very large and complex.

EQUIPMENT:

Overhead projector, screen.

Drafting equipment and scales to scale or measure drawings.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Spence, William P., Architecture: Design, Engineering, Drawing, New York: McKnight & McKnight Publishing Company, 1967.

3) Structural Clay Products Institute, Bricklaying I and III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

5) Sundberg, Elmer W., Building Trades Blueprint Reading, Part I, Chicago: American Technical Society.

I. INTRODUCTION AND MOTIVATION

A. Request comments on how large buildings are constructed. Use responses to set stage for need to understand how to read drawings. Show blueprints of buildings from simple to complex and elicit responses about the meaning of various parts of the drawings. Proceed with lesson and utilization of transparencies to present information.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Principles of orthographic projection.	1. Placement of views and the relationship of one view to the others. 2. Meaning of projection and development of views. 3. Placement of dimensions on drawings.	1. How blueprints, ozalid prints, and other type prints are made.
B. Scale drawings.	1. Need for use of scales in architectural drawing. 2. Scales most commonly used: a. 1/4" = 1'-0" for most plans b. 1/2" and 3/4" = 1'-0" for most sections c. 1" and 1-1/2" = 1'-0" for details 3. How to measure and use scales in drawing. 4. Proper dimensioning techniques.	1. Sampling techniques and scaled down specimens as used by science.
C. Elevation views.	1. Pictorial type drawings. a. Perspective b. Isometric c. Oblique 2. Relationship of elevation views. a. Front view b. Right side view c. Rear side view d. Left side view 3. Frequently elevation views are labeled in the direction they face. a. North b. South c. East d. West 4. Elevation view symbols. a. Standardized symbols are used to indicate materials on elevations b. Present window, door, brick, block, concrete, stone, and other appropriate symbols 5. Dimensions and notes on elevation drawings. a. Note pertaining to materials and finishes b. Notes indicating grades, levels, etc. c. Height, width, and length dimensions	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Use of 90° angles, 45° angles, and 60° angles for projection.	1. Present drawing as a universal method of communication.	1. Discuss symbolism in terms of early civilizations. a. Findings on cave walls, etc. b. Biblical scripts c. Reference to drawings and buildings
1. Develop ability to measure accurately. 2. Develop understanding of scales. a. Scaling down a dimension b. Scaling up a dimension or an object	1. Develop vocabulary as it relates to words used in drawing.	
1. Problems of addition and subtraction of whole numbers and fractions as dimensions.	1. Present concept of symbolism as a means of communication. 2. Develop ability to read and understand conventional abbreviations used in architectural drawings.	1. Discuss need for drawings in terms of technological advancement and large scale buildings. 2. Present concept of mass production and the need for drawings to enable interchangeable parts.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
D. Plan views.	1. Principles of plan view development. a. Cutting planes b. Aspects of offsets 2. Plan view symbols a. Standardized symbols are used but differ from elevation view symbols b. Present appropriate symbols 3. Dimensions and notes on plan views. a. Many informational notes are used b. Material notes c. Dimensions are present for length, width, room placement, and other aspects necessary for building the house	
E. Section views.	1. Principles of sectioning. a. Cutting planes b. Aspects of offsets in the cutting plane 2. Section view symbols. a. Standardized symbols--differ from elevation symbols but many are similar to symbols used in plan views b. Present appropriate symbols 3. Dimensions and notes on section views. a. Sections aid in conveying ideas--hence, dimensions and notes also clarify b. Sections are used to indicate materials, show structural components, or interrelationship of parts	1. Sectioning of specimens for purpose of microscopic observation.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Practice in dimensioning and measurement. 2. Adding and subtracting of dimensions necessary to lay out rooms from dimensions given on the drawings.	1. Reading specifications and other information included with a set of working drawings. a. Reading for understanding b. Reading for accuracy of interpretation	1. Legal aspects of the priority of specifications over the working drawings. 2. Legal responsibility of contractors for accuracy of dimensions and other information on drawings.

III. APPLICATION

A. Present information on principles of orthographic drawing.

B. Have students do simple drawings to reinforce principles.

C. Present various symbols and check student understanding.

D. Have students lay out a foundation plan from a drawing--check dimensions, addition, and subtraction.

E. Have students build simple models of a section to check understanding.

IV. EVALUATION CRITERIA GUIDELINE

A. Explain the reason for why the three views used in orthographic drawings are positioned as they are.

B. What is the front view of a house called?

C. Draw the correct symbol for brick in plan view, section view, and elevation.

D. Have students add and subtract dimensions to enable laying out an offset in a building.

E. Evaluate models to see if students understand section drawings.

V. SUMMARY

A. Buildings are constructed from drawings. Therefore, the construction worker should know how to read and understand drawings. Elevation drawings show the exterior appearance of a building or an interior area. Plan views show room layouts and other area arrangements. Section drawings indicate structural aspects and relationship of parts.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Introduction to orthographic projection

60 minutes -- Principles of elevation drawing

60 minutes -- Reading plan drawing

60 minutes -- Reading section drawings

60 minutes -- Integrated curriculum aspects

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Hepler, Donald E. and Wallach, *Architecture Drafting and Design*, New York: McGraw-Hill Book Company, 1969.

2) National Lumber Manufacturers Association, *Manual for House Framing*, Washington, D. C.: National Lumber Association, 1961.

3) Wilson, Douglas J., *Practical House Carpentry*, New York: McGraw-Hill Book Company, 1957.

INSTRUCTOR'S UNIT PLAN

Unit 5
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Forming and Pouring Concrete Footings

AIM:

To teach methods of forming and placing simple concrete footings.

INSTRUCTIONAL AIDS:

Film - How to Build New Shapes in Concrete, Harrisburg, Pa.: Modern Talking Picture Service, Inc., J. P. Lilley & Sons, 2009 N. 3rd Street (18 minutes, 16 mm, sound, color).

Transparencies - Foundations BSM12, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

Transparencies - Teacher-made showing various form types and placement of structural members for on-site constructed forms.

EQUIPMENT:

16 mm projector, overhead projector, screen.

Transit, leveling rod, stakes, 2 x 4, 2 x 6, 2 x 8, and other sizes of lumber as required, hammers, saws, level, string, shovels, sledge hammer, and nails.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Formwork for Concrete, Detroit: American Concrete Institute, 1959.

3) Huff, Darrell, How to Work With Concrete and Masonry, New York: Harper & Row Publishers, Inc., 1970.

4) Kissam, Philip C., Surveying Practice--The Fundamentals of Surveying, New York: McGraw-Hill Book Company, 1971, 2nd Edition.

I. INTRODUCTION AND MOTIVATION

A. Introduce and show film How to Build New Shapes in Concrete. Generate discussion relative to need for solid footings for masonry work. Lead into discussion on building forms.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Principles of good form construction.	1. A well-designed form should: a. Be easily erected b. Be easily stripped c. Be readily leveled or plumbed d. Be rigid enough to prevent distortion by concrete pressures e. Enable reuse of material f. Provide some means of cleaning debris from formed area	
B. Pressure from freshly poured concrete.	1. Pressures developed are the product of the weight of a cubic foot of concrete times the area times the depth. a. Weight per cubic foot--140 pounds b. Initial set time 2. Control of pressure, height, width, length relationships. a. Force triangles	1. Pressure forces of a true liquid. a. Relating the forces to concrete which acts as a true liquid b. Basic hydraulic or hydrostatic principles
C. Materials for forms.	1. Types of material used. a. Solid wood 1) Douglas fir 2) Spruce 3) Yellow pine b. Manufactured wood 1) Exterior plywood 2) Concrete form plywood c. Steel 1) Sheet metal, usually 10 ga or heavier 2) Angles, channels and other structural shapes 3) Most steel forms are commercially prepared 2. Fasteners. a. Common wire nails b. Duplex or double headed nails 1) Commonly called scaffold or erection nails c. Sizes 1) Common nails--8 to 20 penny lengths 2) Double headed nails--10 and 16 penny lengths d. Bolts--common bolts--5/16" to 3/8" diameter with lengths as required e. Patented ties of various types f. Wire--when carefully used	1. Strength characteristics of various types of wood used for forms. 2. Grain and splitting characteristics of form woods. 3. Water resistant adhesives. 4. Experiments with nails to identify their holding power.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computation of: a. Area b. Volume c. Weights	1. Reading specifications for footings, sidewalks, patios. a. Reading for understanding and accurate interpretation	1. Study of U. S. highway system with consideration of: a. Safety b. Communications c. Economy
1. Computation of area of irregular shapes. 2. Computation of volume and weights of irregular shapes.		1. Safety regulations in the building trades. a. Building excavation safety b. Scaffold safety c. Cassion safety d. Forming safety 2. Structural safety and margin of safety or safety factors in commercial buildings. a. Collapse of some public buildings b. Liability laws
1. Estimating materials required for formwork. 2. Cost breakdown. a. Excavation b. Material c. Labor--erection d. Labor--stripping 3. Translation of penny size to inches.	1. Reading catalogs about commercial forms--read for understanding. 2. Writing requisitions for commercial forms. 3. Reading and understanding strength of material literature. a. Materials b. Concrete c. Holding power of nails	1. Review of some outstanding concrete structures.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
D. Footing form construction.	1. Trench footings--use of soil as form where it will retain its shape and withstand pressure of concrete. 2. Simple one-piece sheathing forms. a. Stake size and placement b. Sheathing sizes 1) Usually 1" x 8" or 2" x 8" c. Stake and sheathing bracing 1) Diagonal bracing 2) Spreader bracing	
E. Sidewalk and patio forms.	1. Same principles as one-piece sheathing forms used for footers. 2. Necessity of good straight well-braced edge forms. 3. Forming curves or radii. a. Materials used b. Tangent points and fairing of curve into straight runs c. Proper bracing techniques	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Geometry as it applies to various triangles formed by brace members. a. Strength of diagonal braces 2. Geometry as it relates to laying out various shapes. a. Rectangle b. Square c. Circles d. Arcs e. Checking for accuracy	1. Building vocabulary as it relates to forms. a. Stakes b. Spreader c. Ranger-sheathing d. Whaler e. Ties f. Etc.	
1. Principles of tangents of circles. 2. Computation of correct center point for scribing curves for walks, etc.		1. Building codes as they relate to sidewalks, gutters and drainage. 2. Enforcement practices for sidewalk repair and snow removal.

III. APPLICATION

A. Discuss the necessity for correct shape, strength, and levelness of concrete forms.

B. Demonstrate uses of various sizes and types of lumber and why each was selected.

C. During practical application, demonstrate use of transit, how to assemble forms, drive stakes, and other aspects of form construction. Prepare subgrade to receive concrete.

IV. EVALUATION CRITERIA GUIDELINE

A. What pressures are exerted against a form?

B. What is a trench form? Where is it used?

C. Why is accuracy important when constructing concrete forms?

D. Must concrete forms be well braced? Why?

E. Demonstrate correct use of the transit.

V. SUMMARY

A. Concrete is a plastic material which acts like a stiff liquid when first placed. Therefore, it is necessary that it be contained in a form until it hardens. Concrete forms must be strong to withstand the pressures exerted by the concrete. Since the form determines the shape and levelness of the finished concrete, the forms must be accurately constructed.

SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Instruction and demonstration of forming techniques

90 minutes -- Integrated curriculum concepts

150 minutes -- Practical application building forms

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Concrete Form Construction, Albany, N. Y.: Delmar Publishers, Inc., 1965.

2) Spence, William P., Architecture: Design, Engineering, Drawing, New York: McKnight & McKnight Publishing Company, 1967.

3) Wagner, Willis H., Modern Carpentry, Homewood, Ill.: Goodheart-Willcox Company, Inc., 1967.

INSTRUCTOR'S UNIT PLAN

Unit 6
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Concrete Masonry (Blocks) Typical Construction Practices

AIM:

To teach basic concrete block laying and the principles of planning for placement.

INSTRUCTIONAL AIDS:

Film - Build With Concrete Masonry, Ann Arbor, Michigan: University of Michigan, Audio-Visual Education Center (20 minutes, 16 mm, sound, color).

Film - ABC's of Masonry Construction, Chicago: Portland Cement Association, 33 West Grand Avenue (10 minutes, 16 mm, sound, color).

Transparencies - Concrete Block BSM10, Concrete Block Line Holders BSM11, Foundations BSM12, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

EQUIPMENT:

16 mm projector, overhead projector, screen.

Materials for making mortar, concrete blocks, block hammer, block chisel, level, rule, line, line blocks, and trowel.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Concrete Block Construction, Chicago: American Technical Society, 1970.

2) Recommended Practices for Laying Concrete Block, Chicago: Portland Cement Association, 1963.

3) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Show films ABC's of Masonry Construction and Build With Concrete Masonry. Use discussion generated by films to lead into presentation of material and demonstration on concrete block laying. If possible, have a skilled block mason other than the instructor demonstrate.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Footings and layout.	1. Need for accuracy in layout. a. Dropping points from intersection of lines from batter boards b. Striking chalklines c. Footings must be thoroughly cleaned and swept before layout and placing mortar d. Final checking and verification of all measurements	
B. Mortar.	1. Proportions for ordinary service by volume. a. Masonry cement--1 part b. Mortar sand--2-3 parts 2. Proportions for heavy service. a. Masonry cement--1 part plus 1 part portland cement b. Mortar sand--4-6 parts c. Enough water in each case to get correct consistency	1. Develop concept of adhesion, cohesion, and fusion. a. Relate principle to mortar and concrete blocks b. Relate principles to other materials
C. First course.	1. Placing corners. a. Corners are placed carefully in correct position 2. Placing block--block placed with thicker portion of face shell up. 3. Stringing the line--from corner block to corner block. 4. Placing full bed of mortar--striking furrow. 5. Buttering end faces and placing blocks. 6. Checking straightness and plumb with level. 7. Placing closure block.	
D. Laying up corners.	1. Placing mortar on wide horizontal face shells. 2. Butter end face shells and face blocks. 3. Check plumb, level, and straightness with the mason's level. 4. Each block is stepped in 1/2 block for each course in each direction. 5. Checking level across corners.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Use of measurement for layout of building on footings. a. Principle of use of plumb bob b. Division as it relates to computing number of blocks required in a wall		1. Industries involved in support of the concrete block industry. a. Manufacturing of equipment b. Cement industries c. Sand industries d. Transportation 2. Develop concept of interdependence of industries.
1. Proportion as it relates to mortar mixes.	1. Develop vocabulary relating to concrete block types and sizes and terms used in the block mason's trade.	1. Standards established and enforced concerning size and quality of concrete blocks. 2. National Bureau of Standards.
1. Review principles of level and plumb. 2. Multiplying multiples of units. 3. Concept of percentage to compute number of blocks in a wall.		1. Testing agencies and testing standards dealing with concrete blocks.
1. Multiples of concrete blocks to establish height of block structures. 2. Laying out story poles for concrete block.	1. Reading directions to ascertain heights of buildings, etc.	

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
E. Laying block between corners.	1. Stringing the line--line must be properly placed at top corner and stretched taut. 2. Throwing mortar on horizontal faces--place adequate amount. 3. Butter end face shells--carefully place block with proper alignment in all directions and top into line--check level and plumb. 4. Do not shift blocks after mortar stiffens--all adjustments must be made when mortar is fresh and plastic. 5. Do not spread mortar too far in advance of actual laying position--water is drawn from mortar and a proper bond cannot be attained. 6. Carefully place fully buttered closure block.	1. Water absorption properties of dry concrete block and other materials. 2. Waterproofing materials used for mortar and for wall parging materials.
F. Tooling.	1. Proper timing--tool when mortar is thumb-print hard. 2. Strike horizontal joints first with 22" long jointer. 3. Strike vertical joints with "S" shaped jointer. 4. Strike off mortar "burrs" with trowel.	1. The effect of "struck" or finished mortar on hardness and watertightness.
G. Control joints and intersecting walls.	1. Demonstrate correct method of producing control joints. a. Function of control joint b. Materials used 2. Intersecting bearing walls. a. Need for structural integrity b. Materials used c. Placement of units 3. Intersecting nonbearing walls. a. Materials used b. Placement of units 4. Intersecting walls with two different widths of blocks. a. Placement of units b. Bonding procedures	1. Expansion and contraction of materials with changes of temperature or moisture. a. Coefficients of expansion

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Division of fractions or fractional parts of a foot relating to height of block structures.		1. Use of concrete masonry as influenced by geographic and climatic conditions. a. Dryness or drainage qualities of subsoils 1) Pennsylvania 2) Florida 3) Michigan or Minnesota b. Temperature variations
	1. Reading directions for use of various tools. a. Raking tools b. Jointing tools	
1. Computations with coefficients of expansion.		

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
H. Setting anchor bolts.	1. Spacing for adequate holding power. 2. Sizes of anchor bolts--length, diameter. 3. Placement in mortar. a. Proper embedding b. Filling cavities	1. Corrosive action of materials in mortar and various metals.

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
		1. Housing regulations dealing with high wind locations and need for adequate anchoring of the house frame to the foundation.

III. APPLICATION

A. Lay out wall section on work area foundation with student help and emphasize full or half block lengths.

B. Demonstrate mixing of mortar. Have students mix mortar.

C. Demonstrate how to throw mortar and place blocks.

D. Have students lay up corners at least three blocks high.

E. Demonstrate working to a line and have students lay blocks to complete wall.

IV. EVALUATION CRITERIA GUIDELINE

A. Why is the initial layout on the footings important?

B. How do you compute the number of blocks required for a given length of wall?

C. Explain how to mix mortar.

D. Have students demonstrate use of the level and line.

E. How are masonry tools cleaned at the end of a work period?

V. SUMMARY

A. The actual process of block laying must be learned by practice. However, practice should be preceded by an understanding of correct procedures. Students should develop a knowledge of correct practices, skill in identifying and laying blocks, an appreciation of quality workmanship, including accuracy. Speed must be developed but not at the expense of quality work.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduction and motivation

45 minutes -- Demonstration and mixing of mortar

60 minutes -- Integrated curriculum concepts

180 minutes -- Practical application

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Day, Richard, The New Concrete and Masonry Guide, Greenwich, Conn.: Fawcett Publications, Inc., 1966.

2) Huff, Darrell, How to Work With Concrete and Masonry, New York: Harper & Row Publishers, Inc., 1970.

3) Type of Workmanship Recommended for Concrete Block Walls, Louisville, Ky.: Louisville Cement Company, Inc., 1957.

INSTRUCTOR'S UNIT PLAN

Unit 7
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Bricklaying - Corner and Stretcher Work for 8" Stretcher Bond Wall

AIM:

To teach the correct methods of laying up corners and using proper joints for stretcher courses in straight brickwork.

INSTRUCTIONAL AIDS:

Film - Basic Bricklaying, McLean, Va.: Structural Clay Products Institute, 1750 Old Meadow Road (12 minutes, 16 mm, sound, color).

Transparencies - Line Blocks and Plumb Bobs BSM3, Common Mortar Joints BSM5, Spreading Mortar BSM6, Laying To a Line BSM7, Inside and Outside Corners BSM13, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

EQUIPMENT:

16 mm projector, overhead projector, screen.

Materials for brick mortar, bricks, brick hammer, level, rule, square, line, line blocks, and trowel.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

3) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Show film Basic Bricklaying and point up the portions concerned with laying corners, leads, and stretchers. Present material via transparencies and lead into actual demonstration of how to do the laying of corners and stretchers.

II. PRESENTATION OF INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Footings and layout.	1. Need for accuracy in layout. a. Dropping points from intersections of lines on batter boards b. Striking chalklines c. Checking corner with square d. Extending leads with 4' level 2. Final cleaning of footings. 3. Final checking and verification of all dimensions.	
B. Spacing bricks at corners.	1. Lay out or space bricks on corners dry. a. Keep end joints uniform b. Place brick for correct bond 2. Bed brick in mortar in correct sequence. 3. Check corner for squareness. a. Extend tail of lead carefully and accurately 4. Build leads to desired height.	1. Strength and rigidity gained by placement of units in a brick wall.
C. Laying face brick to line between leads.	1. Set line for required course. a. Set line to correct points b. Stretch line taut 2. Properly spread mortar bed. 3. Lay bricks carefully to line. a. Disturb line as little as possible b. Keep end joints full and uniform 4. Thoroughly butter and set closure brick. 5. Check all bricks for plumb as they are laid.	
D. Laying backup brick between leads.	1. Bricks should be laid to a line. a. Sometimes masons lay backup bricks without stretching a string b. Best practice is to lay to a line 2. For stretcher bond walls, metal wall ties should be used. a. Two or three bricks apart b. Every other course	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Use of 3-4-5 for checking squareness of corner. a. $a^2 + b^2 = c^2$	1. Reading blueprints and specifications to develop an understanding of how to read and transmit the information into a house structure.	
1. Computations to develop concept of number of bricks required and the width of end joints.	1. Develop vocabulary relating to terms used. a. Leads b. Tails c. Stretcher d. Closure e. Etc.	1. Discuss early civilizations and their use of masonry products. 2. Show film: Prologue in Masonry, McLean, Virginia 22101: Structural Clay Products Institute, 1750 Old Meadow Road (24 min., 16 mm, sound). a. Discuss concepts put forth in film--develop historical appreciation for masonry
1. Develop concept of 1/4-1/2-3/4 as they relate to closure bricks and breaking joints.		
	1. Practice in taking and understanding oral instructions. a. Understanding b. Retention of directions given c. Execution of directions	

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
E. Rake and strike joints.	1. Joints in face brick should be raked and struck according to job specifications. 2. Consider water shedding of joint.	1. Discuss and develop concept of water shedding as established by placing of masonry units. a. Slope of units b. Slope of raked joints c. Smoothness and density of mortar surface

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
		1. Develop concept of job responsibility. a. Responsibility to self b. Responsibility to employer c. Responsibility to customer d. Responsibility to society

III. APPLICATION

A. Demonstrate how to lay out corners on foundation from batter boards. Have students lay out corner on practice floor.

B. Have students mix practice mortar--lime and sand.

C. Demonstrate procedure and sequence for laying corners.

D. Have students lay up corners of at least 12 courses.

E. Demonstrate laying stretchers and closure bricks to a line--have students complete the wall.

F. Have students lay backup bricks.

IV. EVALUATION CRITERIA GUIDELINE

A. Check work of students on wall--check for squareness of corners, height, plumb, and level.

B. How do you compute the number of bricks required to close a given area?

C. How can you check the squareness of a corner with a rule or tape measure?

D. Have students demonstrate their skill at spreading mortar and laying brick to a line.

E. Explain how to clean tools and equipment.

V. SUMMARY

A. Much masonry work consists of laying up corners and the laying of the brick between the corners. To a large degree this comprises most of a mason's work. Therefore, the mason must know how to correctly and accurately lay brick under these conditions. Also, he must develop a high degree of skill and speed at these functions.

VI. SUGGESTED TIME AND SEQUENCE LISTING

45 minutes -- Introduction and motivation

60 minutes -- Demonstration of practices and procedures

75 minutes -- Integrated curriculum concepts

150 minutes -- Practical application

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Atkinson, Henry F., Rough Carpentry and Masonry, New York: McGraw-Hill Book Company, 1969.

2) Structural Clay Products Institute, Bricklaying Vocational Training, Volume 1, McLean, Va.: Structural Clay Products Institute, 1965.

INSTRUCTOR'S UNIT PLAN

Unit 8
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Basic Brick Bonds

AIM:

To teach basic bonds used for common brickwork.

INSTRUCTIONAL AIDS:

Slides - Brick Bonds, McLean, Va.: Structural Clay Products Institute, 1750 Old Meadow Road (29-35 mm slides, color).

Transparencies - Common Mortar Joints BSM5, Brick Courses BSM8, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

EQUIPMENT:

35 mm slide projector, overhead projector, screen.

Material for brick mortar, bricks, brick hammer, level, rule, line, line blocks, and trowel.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

3) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Have dry bricks stacked in configurations with no bond, stretcher bond, header bond, and common bond. When students are seated, exert a uniform force against each stack until they topple. Use this to lead into discussion of need and value of bonds. Show selected slides from Brick Bonds series.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Principle of bonding.	1. Develop concept that although masonry units in themselves have strength, correct bonding is required to have strength in a wall structure. 2. Definition--bonding is the tying of a wall together by lapping across or over at least two other bricks in the course below it. a. Known as breaking joints	1. Strength of walls with aligned joints or stacked bricks as opposed to bonded or lapped joint walls.
B. Stretcher bond.	1. Each brick in each course is lapped one half its length over the brick below. 2. Uses. a. Veneer walls b. Nonbearing partition walls one brick thick	
C. Header bond.	1. Each brick is laid header fashion with each brick in each course lapped one half its width over the brick below it. 2. Uses. a. 8" thick walls b. 8" thick partitions 3. This bond is not too frequently used.	1. Principles of rigidity and strength applied to the various bonds in terms of: a. Height vs. thickness b. Height vs. length c. Height vs. bond
D. Common bond.	1. Five courses are laid as in stretcher bond and the sixth course in header bond and the process repeated throughout the height of the wall. 2. Uses. a. Most generally used bond for all types of masonry walls b. Used extensively for exterior walls	
E. Procedures.	1. Each type bond must be accurately and carefully laid. a. Lay straight to a line b. Keep wall plumb c. Keep wall level 2. Back-up courses must be kept level with face courses to facilitate tying in with headers. 3. Bricks must be properly bedded in mortar and end joints must be full and uniform.	1. Importance of straightness and plumbness in the strength of a masonry wall.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Addition of whole numbers and fractions. a. Figuring height of stretcher courses with brick 2-1/4" thick and mortar joint 3/8" thick b. Computing height of a number of masonry units 2. Intent of problems involving addition of fractions is to develop concept and skill.	1. Development of vocabulary relating to terms used with various bonds.	1. Develop concept of total services offered by a trade union.
	1. Writing a descriptive paragraph to describe how to do something. a. Develop skill in clarity of writing b. Develop concept of conciseness c. Utilize correct vocabulary	1. Develop concept of political action aspects of unionism. a. Discuss lobbying b. Discuss individual action vs. group action c. Discuss democracy and "blind" following of some union members to the union policy
1. Multiplication of fractions. a. Computing amount of mortar to lay 8,000 bricks if it takes 5/8 cu.yd. to lay 1,000 bricks b. Other similar problems		1. Discuss election of union officers. a. International officers b. Local officers c. Grievance committees 2. Develop concept of voting in a democracy.
1. Division of fractions to compute number of header courses in a given wall height.	1. Reading for comprehension. a. Articles of advertisement b. Factual information c. Directions d. Regulations--ordinances, etc.	

III. APPLICATION

A. Introduction and motivation.

B. Develop concept of bonds and demonstrate basic bonds.

C. Integrated curriculum concepts.

D. Practical application--actual work in laying bricks in the various bonds.

E. Testing rigidity of wall structures.

IV. EVALUATION CRITERIA GUIDELINE

A. Sketch the three bonds presented in this lesson.

B. What is the difference between a structural bond and an ornamental bond?

C. What is a header course?

D. What is the purpose of using bonds?

E. What relationship is there between the height of a wall and its strength?

F. Why is it important that the backup brick courses be level with the face courses in a common bond wall?

V. SUMMARY

A. Structural strength and rigidity are obtained in masonry walls by the mortar joints and also by the configuration of the bricks. Special configurations which tie the bricks together are called bonds. The mason must know various bonds and their uses so that he can construct strong, sound walls.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation--show slides from *Brick Bonds* series

60 minutes -- Demonstrate procedure for laying bricks in various bond configurations

90 minutes -- Integrated curriculum concepts

150 minutes -- Practical application laying bricks

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Day, Richard, The New Concrete and Masonry Guide, Greenwich, Conn.: Fawcett Publications, Inc., 1966.

2) Ray, Jesse Edgar, The Art of Bricklaying, Peoria, Ill.: Charles A. Bennett Company, Inc., 1971, 3rd Edition.

INSTRUCTOR'S UNIT PLAN

Unit	9
Lesson	1
Time	6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Rowlock, Soldier, and Lintelwork

AIM:

To provide instruction and practice in laying rowlock, soldier, and lintel courses in brick masonry.

INSTRUCTIONAL AIDS:

Film - Brick and Stone Mason, DesMoines, Iowa: Carl F. Mahnke Producer (11 minutes, 16 mm, sound).

Transparencies - Teacher-made, showing configuration and nomenclature in rowlock, soldier, and lintel situations.

EQUIPMENT:

16 mm projector, overhead projector, screen.

Materials for brick mortar, bricks, lintel steels, rule, level, square, brick hammer, line and line blocks, and trowel.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 1, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying I and II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Ask students how they would finish the top of a brick wall or the opening over a door or window. Use their responses to lead to a need for information on rowlock, soldier courses and lintelwork. Use teacher-made transparencies to point out uses of the rowlock, soldier and lintel courses and show film Brick and Stone Mason to reinforce the general work aspects of the mason trade.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Need for rowlock and soldier courses.	1. Definition. a. Rowlock--a brick bond or course set on edge so that the 4" width is vertical b. Soldier--a brick bond or course in which the bricks are set on end so that the 8" length is vertical 2. Uses. a. Rowlock courses are used as finish courses at sills, headers, borders, and as parts of cornices and copings b. Soldier courses are also used for the above purposes but more frequently as units above fireplace openings, windows, and doors. c. Decorative work d. To form watersheds at window sills and for copings and finish courses on walls to prevent water from entering the wall and perhaps causing efflorescence 3. Important aspects of laying. a. Final course of bricks should be level and true to line b. Soldier and rowlock must be carefully spaced to provide proper appearance 1) Three rowlock or soldier bricks should be same length as one stretcher c. Care must be taken to be sure soldiers are plumb on face and edge d. Where soldier or rowlock courses are sloped the slope should be uniform e. Where rowlock courses are used for sills the front of the sill should project 1/2"-3/4" beyond face of wall to provide a drip	1. Principles involved in sloping or slanting soldier and rowlock courses to form watersheds. a. Need for well filled and tight joints b. Degree of slope used for appearance and effective watershed c. Considerations in developing a drip edge 2. Efflorescence on bricks. a. Causes b. Chemical reaction c. Removal methods
B. Lintels.	1. Definition. a. The structural member which supports the structure over an opening such as a door or window 2. Responsibility for structural soundness. a. Primary responsibility rests with the architect or designer	1. Forces acting on a beam. a. Uniformly loaded--supported both ends b. Asymmetrically loaded--supported both ends c. Cantilevered 2. Principles of galvanic action and chemical reaction of mortar ingredients and steel.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Slope computations in terms of inches and fractions of inches per foot. 2. Compute wages in terms of hours worked and wage per hour. a. Wage computations b. Deductions	1. Reading literature of a technical nature and develop an interest in literature for recreational reading. a. Reading paperbacks b. Reading selected American literature 2. Writing reports on literature. Read and stress: a. Grammar b. Comprehension c. Interpretation of the plot or intent of the story	1. Wage scales and the legislation of prevailing wage paid on state and federally financed projects. 2. Selected social studies topics which would assist in qualifying for GED tests.
1. Computation of simple loads on lintels by use of computation of weight of materials by square footage and volume. 2. Use of tables concerning load-span relationship for selecting lintels. a. Channels b. Angle iron c. I and H beams	1. Study blueprints and blueprint reading as a means of communications. a. Use blueprints in BL-I and BL-II b. Place emphasis on reading notes, etc. on plans	1. Study architectural styles of some famous buildings to identify use of rowlock and soldier bricks on copings and facades.

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	b. Application responsibility rests with contractor and craftsmen building the structure 1) Workers who place structural steel, framing lumber, etc. 2) Masons who place concrete and masonry units 3. Materials used. a. Steel angle iron either individually or back to back b. I beams and angle irons used jointly c. Channel iron with angle iron bolted, riveted, or welded to web of channel d. Show various configurations and placement of lintel members 4. Bearing on structural units. a. Length of bearing on wall b. Bearing on pilasters c. Bearing on piers d. Bearing on columns or other structural members housed in a chase 5. Bedding in mortar--principles used to assure good bond and prevent rust bleeding. 6. Setting bricks on lintels. a. Cutting bricks to fit for stretchers b. Cutting bricks for rowlock appearance c. Cutting bricks for soldier course d. Bedding in mortar 7. Joining and otherwise striking joints to assure correct appearance and watertightness. 8. Use of concrete or masonry lintels. a. Precast lintels b. Cast in place lintels c. Reinforced concrete masonry units with concrete poured after placement	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
3. Develop an understanding of corbel and build concept of support required to obtain offset. Also develop concept of corbel as it relates to load over an opening.		

III. APPLICATION

A. Introduction and motivation.

B. Demonstration of configurations of rowlock and soldier courses via transparencies and dry brick setups.

C. Demonstration of laying procedures for rowlock and soldier courses.

D. Practice in actual laying of bricks.

E. Demonstration of placing various lintels and laying bricks.

F. Practice in laying stretcher, rowlock and soldier courses on lintels.

IV. EVALUATION CRITERIA GUIDELINE

A. List situations in which you would use rowlock bond, soldier bond.

B. Indicate the amount of slope placed on rowlock bricks for window sills.

C. Demonstrate how to lay rowlock and soldier bond bricks.

D. Compute load over a window opening.

E. Sketch various configurations of steel units used as lintels.

F. Indicate various uses of masonry lintels.

V. SUMMARY

A. There are many situations in which rowlock and soldier courses of brick masonry must be used to obtain a finished and decorative appearance. Masons must know how to correctly lay the bricks to obtain a quality structure which is aesthetically pleasing. He must know correct procedures, nomenclature, and configuration. Also, since buildings do have openings, he must know how to place lintels and lay the bricks over the lintels. Hence, study and skill in this area are imperative.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Demonstration of rowlock and soldier bonds

60 minutes -- Integrated curriculum techniques

60 minutes -- Presentation of material on lintels

120 minutes -- Practical application

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Atkinson, Henry F., Rough Carpentry and Masonry, New York: McGraw-Hill Book Company, 1969.

2) Heppa, Victor, Mathematics I for Masons, Brunswick, N. J.: School Board, Vocational Division, Curriculum Laboratory, 1959.

3) Spence, William P., Architecture: Design, Engineering, Drawing, New York: McKnight & McKnight Publishing Company, 1967.

INSTRUCTOR'S UNIT PLAN

Unit 10
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Brick Veneer Work

AIM:

To teach methods of laying bricks for brick veneer and also how the bricks are tied to the wood frame.

INSTRUCTIONAL AIDS:

Transparencies - Brick Veneer BSM9, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

Transparencies - Teacher-made, showing brick veneer configurations.

Slides - Teacher-made, showing various types of veneer work at various stages--slides of various types of wall ties.

EQUIPMENT:

35 mm slide projector, overhead projector, screen.

Tools, materials, etc. required for practice work on veneer work.

Examples of various types of wall ties.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Structural Clay Products Institute, Bricklaying I and II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

3) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Ask students what they perceive the structure of most contemporary masonry homes to be. Try to get responses relative to brick or stone veneer. Solicit reason why veneer structures would be used and use this information to lead into a need for knowledge of brick veneer structures.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Brick veneer on wood framing.	1. Definition. a. Single thickness of brick usually laid 4" wide on solid foundation over the sheathing, but not touching, of a wood frame structure 2. Flashing at foundation of brick. a. Frequently copper flashing is nailed to sheathing and extends over foundation to direct condensation to outside b. Weep holes are used to provide exit for water 3. Wall ties are used to assist in obtaining structural integrity. a. Principle of corrugation of ties b. Correct method of nailing ties to wall c. Precautions used to prevent cracking of green joints when nailing ties d. Spacing of wall ties 1) Spaced every three or four bricks apart 2) Spaced every fourth or fifth course in height 3) Staggering of ties can be used to help void cracks e. Nailing should provide for some degree of flex 4. Bonds used. a. Most common bond used is stretcher bond b. Actually no other bonds can be used but the appearance of various bonds can be attained by breaking bricks 5. Air space. a. 1" air space clean and free of mortar should be maintained to prevent moisture transfer to the sheathing	1. Expansion and contraction of materials as it relates to use of wall ties. 2. Properties of zinc as galvanizing material on steel wall ties to prevent rusting.
B. Stone veneer on wood frame.	1. Principles of laying stone veneer on wood frame are about the same as for brick. However, sometimes the stone is greater than 4" thick. 2. Stone should be properly fitted and laid in the selected pattern. a. Random ashlar b. Coursed rubble c. Random rubble	1. Discussion of cleavage lines and other 'grain' characteristics which would assist in cutting or shaping stone to size. 2. Study of the effect of air pollutants on various types of stone.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Practice in computing surface area. 2. Computing number of bricks laid per hour. 3. Computing wages. a. Per hour basis b. Piecework basis	1. Writing a resume' of one's self for presentation in seeking employment. 2. Development of knowledge of the outline. a. Need for concise, accurate notes b. Selecting important points	1. Study of tools of mankind. a. Ancient to present b. Social impact c. Technological impact 2. Study of various types of building structures to control environment. a. Tropical structures b. Structures in subtropics c. Structures in temperate areas d. Structures in cold areas
1. Computation of the amount of stone needed for veneering a certain area.		

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	3. Wall ties are used and spaced on approximately the same centers as for brick. 4. Air space is maintained.	
C. Brick and stone veneer on masonry.	1. Definition. a. Brick or stone veneer placed over a concrete block wall but which is not bonded into the concrete block except by ties 2. Wall ties are laid in the joints of the concrete block when block is laid and are left to protrude to veneer facing side. a. Ties are spaced to accommodate brick coursing b. Vertical spacing is every two or three courses 3. Air space is maintained to form moisture barrier.	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Drawing and dimensioning diagrams to ascertain spacing of wall ties.	1. Building reading skills by reading in technical periodicals.	

III. APPLICATION

A. Introduce lesson and teach principles of veneer work.

B. Have students lay out and apply wall ties.

C. Discuss safety insofar as cuts from sharp edges and burrs of wall ties is concerned.

D. Student practice in laying bricks.

IV. EVALUATION CRITERIA GUIDELINE

A. Explain how to space and affix wall ties for brick veneer.

B. Why are weep holes necessary?

C. Of what importance is the air space between the bricks and the sheathing?

D. Can bonds other than stretcher be used in a 4" veneer wall?

E. Why must care be taken to prevent vibration of the wall when wall ties are in green mortar?

V. SUMMARY

A. Many homes are constructed in which brick veneer work is used for the exterior finish. The mason must be able to properly lay veneer work to assure sound, tight structures. Therefore, the beginner must learn how to locate and affix wall ties, lay brick, and also learn the other technical aspects of brick veneer work.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Explanation and demonstration of procedures for laying brick and stone veneer on frame

120 minutes -- Practical application

30 minutes -- Explanation and demonstration of procedures for laying brick and stone veneer on masonry

90 minutes -- Practical application

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Frost, William and Boughton, R. V., Modern Practical Brickwork, London: Batsford Publishing Company, 1954.

2) Jones, David T., Face Brickwork (Serial 1832-4), Scranton, Pa.: International Correspondence Schools, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 11
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Practice in Laying the 8" American Bond Wall

AIM:

To provide time for students to build skill in laying bricks in the American Bond wall. To reinforce skills learned in Unit 8.

INSTRUCTIONAL AIDS:

Slides - Contemporary Bearing Wall, McLean, Virginia: Structural Clay Products Institute, 1750 Old Meadow Road (60--35 mm, color).

EQUIPMENT:

35 mm slide projector, screen.

Materials for brick mortar, bricks, rule, level, brick hammer, trowel, line, and line blocks.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 1, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Discuss with students the necessity of developing skill and speed in laying bricks. If possible, have students observe a master bricklayer and make note of the speed, rhythm, and skill with which he works. Attempt to have students realize that such skill is developed by correct procedures and practice and also that such skills are obtainable.

Note: The intent of this unit is to provide practice time for students. Hence, there will not be related information in the following section concerning science, math, communications, and social studies concepts.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Placing and laying corner bricks and establishing leads.	1. Locate and lay out corners. a. Locate corners at correct points b. Be sure corner is square c. Strike lines on footing 2. Place first header course bricks in correct configuration. a. Locate bricks dry to check configuration 1) Select good square bricks for corners b. Properly locate bricks and bed in mortar 3. Extend leads. a. Check spacing of bricks between leads 4. Lay up six courses to extend lead to next header course.	
B. Lay stretchers between leads.	1. Lay stretchers to a line being sure they are level and plumb. 2. Properly bed and mortar all bricks. 3. Carefully mortar and fit closure brick.	
C. Lay backup bricks.	1. Lay backup bricks to a line to keep wall straight. 2. Check height of backup courses. a. Sixth course of backup bricks must level with exterior course	
D. Lay next header course.	1. Be sure header courses break joint at correct position. 2. Keep header courses level. 3. Lay headers to line. 4. Always check for level and plumb.	
E. Lay up lead to next header course.	1. Run lead to header course, racking back on each lead. 2. Repeat process as before.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
F. Skill development.	1. Students should correctly practice correct skill development. a. Correct procedure should be emphasized over speed 1) Speed will develop with correct practice 2) Speed without correct or quality work is worthless 2. Learn correct configuration. 3. Practice correct trowel procedure. 4. Spread mortar correctly. 5. Butter brick ends or sides properly. 6. Carefully work to a line--learn to sight bricks for level but check with a level. 7. Practice cutting bricks. 8. In all instances try to develop speed but not at the expense of quality work.	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*

III. APPLICATION

A. Review procedure for laying bricks in the American Bond manner.

B. Demonstrate procedure for laying bricks--emphasize quality work.

C. Practical application--have students practice laying up walls. Carefully check procedure, accuracy, and quality of work.

D. Evaluate work.

E. Have students tear down walls, clean bricks, separate practice mortar, and clean tools.

IV. EVALUATION CRITERIA GUIDELINE

A. During the process of laying bricks, carefully and frequently evaluate work procedure and quality.

B. Evaluate student's development of reasonable speed and skill.

C. Evaluate cleanup of tools and materials.

V. SUMMARY

A. The apprentice must develop skill and speed in the trade. The only way to do this is practice and practice with intent to do correct and quality work while constantly developing speed. Hence, correct practice is of paramount importance.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

45 minutes -- Demonstration of correct procedures

265 minutes -- Practical application

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Atkinson, Henry F., Rough Carpentry and Masonry, New York: McGraw-Hill Book Company, 1969.

2) Day, Richard, The New Concrete and Masonry Guide, Greenwich, Conn.: Fawcett Publications, Inc., 1966.

3) Ray, Jesse Edgar, Revised by Harold Johnson, The Art of Bricklaying, Peoria, Ill.: Charles A. Bennett Company, Inc., 1971, 3rd Edition.

INSTRUCTOR'S UNIT PLAN

Unit 12
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Scaffold Erection and Construction

AIM:

To teach how to erect metal scaffolding and build wood scaffolds.

INSTRUCTIONAL AIDS:

Transparencies - Teacher-made, showing principles and methods of wood scaffold construction.

Slides - Teacher-made, showing constructed scaffolding and commercial metal scaffolds in place.

EQUIPMENT:

Overhead projector, 35 mm slide projector, screen, materials for building wood scaffolds and samples of various types of metal scaffolds.

PRIMARY REFERENCES:

1) Ulrey, Henry F., Carpenter's and Builder's Library, Vol. No. 4, Indianapolis: Theodore Audel, 1967.

2) Wagner, Willis H., Modern Carpentry, Homewood, Illinois: Goodheart-Willcox Company, Inc., 1969.

I. INTRODUCTION AND MOTIVATION

A. Discuss need for scaffolding to enable men to work at some height above ground and point out the need for safe structures. Show slides of scaffolds in various applications and proceed with the lesson.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Material selection.	1. Select only clear, sound, straight grained material. a. If knots are present, they must be sound and straight b. No splits or checks 2. Sizes. a. Uprights are sized according to height to be scaffolded 1) Minimum size - 2" x 4" 2) Common size over 8'-0"--4" x 4" b. Ledger blocks minimum size - 2" x 6" c. Cross ledgers doubled--2" x 4" or single 2" x 6" d. Walk planks - 2" x 10"	1. Tests to compare strength of straight grained wood with slash grained wood.
B. Construction types.	1. Two pole structures. 2. Single pole with ledger blocks. 3. Lean-to. 4. Suspended.	
C. Construction principles.	1. Uprights should be straight and plumb and braced to prevent flexing. 2. Base pads should be adequate size to prevent sinking into soil. 3. Wall ledgers should be securely nailed to wall. 4. Cross ledgers should be level and securely attached to uprights and/or wall ledgers. 5. Cross ledgers must be spaced to accept platform boards and usually not more than 5'-0" apart.	
D. Construction methods.	1. Preparation of site. a. Leveling b. Clearing debris 2. Placement and sizing of foot pads. 3. Placement and nailing of wall ledgers. 4. Plumbing uprights and nailing cross ledgers. 5. Nailing cross braces.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Review span strength formulas and computations as they relate to scaffold structures.	1. Read about Leonardo da Vinci in terms of some of his inventions and structures. 2. Reading for understanding.	1. Investigate use of elevators on construction sites. a. Personnel elevators b. Material elevators c. Hoists for brick and block, etc. to scaffolds
1. Review geometry principles as they relate to bracing. a. Strength of a square structure b. Strength of a cross-braced structure c. Strength loss from bowing or flexing of members		
	1. Read literature on various buildings and their architects. a. Develop appreciation for aesthetics in both writing and art b. Develop appreciation for men involved	1. Discuss scaffolding or methods used to construct famous structures. a. Pyramids b. Colosseum c. Saint Paul's Cathedral

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
	6. Placing walk planks. 7. Nailing guard rail.	
E. Manufactured scaffolding.	1. Presentation of types. 2. Bracing methods. 3. Height/width relationship for railing staging. 4. Erection methods. 5. Maintenance procedures.	
F. Ladders.	1. Types. a. Extension b. "A" ladders c. Stepladders 2. Materials. a. Wood b. Aluminum c. Magnesium 3. Uses. a. Inspect before use b. Be sure feet rest on a solid level or leveled surface c. Check height/slope relationship	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Investigate safety regulations of Bureau of Labor and Industry relative to use of scaffolds and ladders.

III. APPLICATION

A. Discuss principles of material selection, bracing for rigidity, and bracing for strength. Use transparencies to show methods of construction and follow up with practical application and construction of scaffolds. Erect several types of manufactured scaffolding to illustrate methods of assembly.

IV. EVALUATION CRITERIA GUIDELINE

A. List safety rules relative to construction and use of scaffolds.

B. Why must clear, knot-free lumber be used for scaffolds?

C. What precaution must be taken to prevent the uprights of scaffolds from sinking into the ground?

D. Why should joint systems on metal scaffolding be kept free of rust and other foreign matter?

E. What is the maximum allowable spacing of horizontal support sections in scaffold construction?

V. SUMMARY

A. Scaffolds or staging are frequently used to enable men to work at some height on building construction. These structures must be strong enough to support men and materials with a high degree of safety. Therefore, the carpenter or mason must know the correct and safe methods of erecting and using scaffolds.

VI. SUGGESTED TIME AND SEQUENCE LISTING

20 minutes -- Introduction and motivation

60 minutes -- Presentation of principles and methods

100 minutes -- Integrated curriculum concepts

150 minutes -- Practical application

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Various catalogues and bulletins on manufactured scaffold and staging systems.

INSTRUCTOR'S UNIT PLAN

Unit 13
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Special Bonds Used in Bricklaying

AIM:

To present various bonds used in bricklaying and provide practice time for laying same.

INSTRUCTIONAL AIDS:

Slides - Use selected slides from Brick Bonds, McLean, Virginia: Structural Clay Products Institute, 1750 Old Meadow Road (29--35 mm, color).

Transparencies - Teacher-made, showing configuration of special and decorative bonds.

EQUIPMENT:

35 mm slide projector, overhead projector, screen.

Materials for brick mortar, bricks, brick hammer, chisel, rule, level, square, trowel, line, and line blocks.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 1, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Show selected slides from the *Brick Bonds* series and lead discussion toward the necessity of knowing how to lay different bonds for reasons of appearance and strength.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. English bonds.	1. Two types of bond. a. Plain English 1) Shade shift is zero 2) English bond has 2" closure at corner 3) Every other cross is distorted to a slight degree b. English Cross or Dutch 1) Shade shift is one-half a brick 2) Dutch bond has three-quarter bat at corner 3) All crosses are perfect 2. English bond corner is started with brick and then a queen closure. 3. English Cross or Dutch bond starts with a three-quarter bat.	1. Test rigidity and strength of walls erected by various bonds. a. Lay up representative sections 3'-0" x 3'-0" x 8" b. Subject sections to various loads 1) Direct compression 2) Side thrust 3) End thrust
B. Flemish bonds.	1. Two types of bond. a. Single Flemish 1) Shade shift is three-quarters of a brick 2) Headers and stretchers alternate in each course b. Double Flemish 1) Shade shift is one and one-quarter bricks 2) A header and then two stretchers alternate in each course c. Other variations 1) Shade shift is one and three-quarter bricks 2) A header and then three stretchers alternate in each course 3) Shade shift is two and one-quarter bricks 4) A header and then four stretchers alternate in each course	
C. Garden wall bonds.	1. Used to present acceptable outside faces on both sides. 2. Generally consists of combined stretcher and header courses with two or more stretchers between headers. a. There are no blind joints	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Develop vocabulary and understanding of the following: a. Bond b. Bond stones c. English bond d. Dutch bond e. Flemish bond f. Double Flemish bond g. Compression h. Header	1. Develop an understanding of the election process. a. Local elections b. County elections c. State elections d. National elections
1. Develop or reinforce concepts of various multiples of bricks to enable proper breaking of joints in Flemish and other bond walls. a. Reinforce concepts concerning simple and compound fractions b. Practice in arrangements of bricks for various configurations	1. Write description of how to lay bricks in the English or Flemish bond fashion.	1. Provide voter registration information.
	1. Practice in grammar and other exercises providing information for GED exam.	

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
D. Rolok Bak Wall.	1. Type of cavity wall used for economy. a. Not for great wall loads b. Not true cavity wall 2. Start with header course. 3. Subsequent courses on exterior face are laid common bond. 4. Interior courses are laid on edge in the common bond fashion. 5. At the sixth course the header course is again utilized.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Responsibility as it relates to voting and normal adult life.

III. APPLICATION

A. Show slides in Brick Bonds series.

B. Demonstration of how to lay various bonds.

C. Practical application--student experience in laying bricks for various bonds.

D. Summary and evaluation.

IV. EVALUATION CRITERIA GUIDELINE

A. Have students sketch each course of English, Flemish, and other bonds to ascertain whether students know correct brick configuration.

B. Evaluate quality of student work--check bond, straightness, level, and plumb.

C. Have students demonstrate how to lay out for selected bonds.

D. Where are certain bonds used and why?

V. SUMMARY

A. Architects, at times, specify the use of various bonds to create various designs and patterns for aesthetic reasons as well as for structural strength reasons. Therefore, the mason must be able to properly and efficiently lay bricks in the various bonds. The apprentice mason must learn the correct method and also develop a reasonable degree of speed of laying the bricks.

VI. SUGGESTED TIME AND SEQUENCE LISTING

40 minutes -- Introduction and motivation

50 minutes -- Demonstrate how to lay the plain English bond

180 minutes -- Practical application--students lay English bond

30 minutes -- Demonstrate how to lay Dutch bond

60 minutes -- Practical application--students lay Dutch bond

(Evaluation to take place concurrently with practical application)

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Johnson, Franklin B., *Designing, Engineering and Constructing with Masonry Products*, Houston, Texas: Gulf Publishing Company, 1969.

2) Jones, David T., *Face Brickwork*, Scranton, Pa.: International Correspondence Schools, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 14
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Special Bonds Used in Bricklaying

AIM:

To provide additional practice time for students to learn how to lay bricks in various bonds.

INSTRUCTIONAL AIDS:

Slides - Use selected slides from Brick Bonds, McLean, Virginia: Structural Clay Products Institute, 1750 Old Meadow Road (29--35 mm, color).

Transparencies - Teacher-made, showing configuration of special and decorative bonds.

EQUIPMENT:

35 mm slide projector, overhead projector, screen.

Materials for brick mortar, bricks, brick hammer, chisel, rule, level, square, trowel, line, and line blocks.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 1, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Review the progress of students and point out good points and errors in their work. If necessary, use slides and transparencies to review the Flemish bond and Garden wall bond. Review techniques which will enable students to attain greater skill and speed.

II. PRESENTATION OF INTEGRATED CONCEPTS

A. The material presented in Unit 13 applies in this unit. The material concerning Flemish and Garden wall bonds may be presented in this unit or may have been presented in Unit 13. In any event, the practical application skills cannot be learned in six hours and, hence, the thrust of this unit is to provide practice in laying bricks in the various bonds.

III. APPLICATION

A. Review good points and problems relating to laying bricks in various bonds.

B. Demonstrate how to lay the single and double Flemish bond.

C. Practical application.

D. Demonstrate how to lay the Garden wall bond.

E. Practical application.

F. Summary and evaluation.

IV. EVALUATION CRITERIA GUIDELINE

A. Explain methods and values gained from various bonds.

B. Demonstrate how to rack up a corner for the Flemish bond.

C. Evaluate quality of student work.

D. Check Garden wall bond to see that both faces are presentable.

E. Explain how to clean tools and equipment.

V. SUMMARY

A. The skilled mason has the knowledge and skill to lay bricks in various bonds. The apprentice must learn, through study, the necessary knowledge about the configuration of the various bonds and must also develop, through practice, the skills necessary. In all instances, the student must put stress on quality work and build skill in this context.

VI. SUGGESTED TIME AND SEQUENCE LISTING

20 minutes -- Review and motivation

40 minutes -- Demonstrate single and double Flemish bonds

120 minutes -- Practical application--laying the Flemish bonds

40 minutes -- Demonstrate how to lay Garden Wall bond

120 minutes -- Practical application--laying the Garden Wall bond

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Johnson, Franklin B., Designing, Engineering and Constructing with Masonry Products, Houston, Texas: Gulf Publishing Company, 1969.

2) Jones, David T., Face Brickwork, Scranton, Pa.: International Correspondence Schools, 1960.

INSTRUCTOR'S UNIT PLAN

Unit 15
Lesson 1
Time 12 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Construction of Brick and Concrete Block Piers, Pilasters, and Chases

AIM:

To teach the correct method of laying piers from brick or concrete block. Also to present information on chase construction.

INSTRUCTIONAL AIDS:

Transparencies - Pilasters and Chases BSM14, Foundations BSM12, Philadelphia: DCA Educational Products, Inc., 4865 Stenton Avenue.

Transparencies - Teacher-made, showing pier configurations, chase configurations, and pilaster configurations.

EQUIPMENT:

Overhead projector, screen.

Materials for brick mortar, bricks, trowel, hammer, level, square, rule, and line, if required.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Concrete Block Construction for Home and Farm, Chicago: American Technical Society, 1971.

2) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 2, Chicago: American Technical Society, 1971.

3) Structural Clay Products Institute, Bricklaying I, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Show a transparency of a steel beam with very little grip on a brick or block wall and elicit comments relative to how more grip could be provided. In a similar manner, lead discussion into methods by which pipes or ducts could be kept flush with a wall surface. Show transparencies to present chase and pier concepts.

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
A. Definition of terms.	1. Pilaster--a rectangular column built in as an integral part of the wall to provide rigidity and increase the bearing surface for beams. a. Is an integral part of the wall b. Is treated structurally as a column 2. Pier--a square, rectangular, or round column-like structure to support beams or floor structures. Also, a pillar supporting one side of an arch or a supporting section of wall between openings. 3. Chase--a channel cut or built into a masonry wall to allow space for receiving pipes. A recess built into a wall to receive ducts. a. Chases usually run vertically b. Chases may run horizontally but care must be taken not to weaken the wall	1. Strength obtained by: a. Increasing vertical rigidity b. Increasing bearing surface for beams c. Decreasing long length of wall between pilasters
B. Pilasters.	1. Major considerations. a. Tie-in with main wall structure 1) Pilaster must be designed to become an integral part of the wall 2) Usually one block is laid header fashion on alternate courses to tie pilasters to wall b. Placement 1) To provide bearing under beams 2) To decrease wall span 2. Pilasters in concrete block walls. a. Sizes are usually multiples of 4 or 8 inches so that block will "work" b. Common sizes 1) 8" x 24" in 8 inch wall 2) 4" x 24" in 8 inch wall 3) 8" x 24" in 12 inch wall 4) 4" x 16" in 12 inch wall	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Compute the number of additional bricks or concrete blocks needed to erect a pilaster of a given size. 2. Compute sizes of pilasters of various configurations.	1. Develop vocabulary relating to piers, pilasters, and chases. a. Column b. Lintel c. Horizontal d. Vertical e. Pier f. Flush g. Recess 2. Write sentences using the above words.	1. Study social studies concepts for qualification of GED. a. Aspects of U. S. history b. Contemporary social problems
	1. Oral explanation of how to erect a pier.	

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
	3. Pilasters in brick walls. a. Sizes are usually in multiples of 4" or the width of a brick b. Brick may also be cut to provide a pilaster of a desired width c. Extension from wall is usually 4-1/4 inches or 8-1/2 inches d. Many tie-in configurations are possible	
C. Piers.	1. Major considerations. a. The area of the pier base must be proportionate to its height to prevent flexing or bending in the vertical plane b. Configurations which provide for breaking of joints on piers supporting heavy loads c. Vertical--carefully plumbed piers on sound foundations	1. Build the concept of the lintel or post and beam. a. Piers as posts or walls at openings b. Build concept of compressive strength
	2. Piers built within concrete block walls or as an integral part of the wall. a. 8" x 8" x 16" concrete block providing 16" x 16" pier b. 8" x 12" x 16" concrete block providing 24" x 24" pier 3. Piers built as an integral part of brick walls. a. Pier sizes are in multiples of 4" or brick width b. Configurations must provide for adequate tie-in 4. Free standing piers. a. May be either of concrete masonry or brick b. Concrete masonry piers may be built in many configurations 1) Square or round columns of a single block, stacked--sizes 16" square or 12"-16" round 2) Configurations built up with 12" x 16" to almost any size 3) Blocks must be adequately bedded in mortar and thoroughly tied in	

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
1. Computation of area of a pier. 2. Figuring cubic content of concrete required for pier footing if pier is 24" x 24" and footing is one foot thick.	1. Reading of literature of early American writers. a. Identification of style b. Consideration of content of writings 2. Review of material related to GED examinations.	1. Develop an understanding of Planning Commissions and their functions.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	c. Brick piers may also be built in many configurations 1) Configurations may be almost of any type which provide proper bond 2) Sizes are usually in multiples of brick width but by cutting bricks other sizes are possible 3) Bricks must be adequately bedded in mortar	
D. Chases.	1. Purpose. a. To house pipes b. To accept ducts or other materials to provide a flush wall surface 2. Chase design. a. Walls with chases should be designed by qualified engineers b. Chases should not be built in walls less than 12" thick c. Chases should not exceed a depth of more than 1/3rd the wall thickness d. Horizontal chases should not exceed more than 6' in length, unless 1) Wall is designed to provide adequate strength, exclusive of the chase depth 2) Pilasters are placed every 6' to provide rigidity 3. Joints around chases should be properly filled and well struck.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Develop an understanding of terminology used in Zoning Regulations or Ordinances and Building Codes. 2. Read for understanding and comprehension.	1. Discuss zoning ordinances and their implementation.

III. APPLICATION

A. Introduce material and amplify with transparencies.

B. Demonstrate how to build pilasters and have students construct block and brick pilasters.

C. Demonstrate how to build piers and have students construct brick and block piers.

D. Demonstrate how to build chases and have students construct brick and block chases.

E. Summary and evaluation.

IV. EVALUATION CRITERIA GUIDELINE

A. Why are pilasters utilized in wall structures?

B. Why is it important that pier units be laid level and also that the pier be plumb?

C. Are walls weakened by chases?

D. How do building codes control chase size?

E. What is a pilaster?

F. Why are most pilasters built in multiples of 4" or 8"?

V. SUMMARY

A. Frequently, walls must be strengthened by the use of pilasters or piers and also support must be constructed to provide bearing for beam and other structural members. Usually the interior walls of buildings are straight without pipes and ducts projecting into the room. Therefore, masons must know how to properly construct these units when required. Also, since these units are important in the structural soundness of buildings, they must be done in a quality manner. Hence, practice by the apprentice is necessary.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Demonstration of pilaster construction

120 minutes -- Practical application

120 minutes -- Integrated curriculum concepts

INSTRUCTOR'S UNIT PLAN

Unit 16
Lesson 1
Time 12 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Building Arches

AIM:

To teach how to lay out, form and lay masonry units for arches.

INSTRUCTIONAL AIDS:

Slides - Teacher-made, showing arch structures used in various buildings and bridges.

Transparencies - Teacher-made, showing types of arch forms or temporary arch supports. Also show arch types and nomenclature.

EQUIPMENT:

35 mm slide projector, overhead projector, screen.

Material for brick mortar, bricks, rule, level, square, trowel, trammel points, hammer, and saws. Required wood to build arch support and steel lintels for flat arches.

PRIMARY REFERENCES:

1) Barr, Donald, How and Why Wonder Book of Building, Columbus, Ohio: Charles E. Merrill Publishing Company, 1964.

2) Graham, Frank D., Masons and Builders Guide, Volume 2, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Show slides of famous bridges and buildings which exemplify the various types of arches. Ask students for reasons of why arches are used and direct discussion to how the arches could have been built, particularly old Roman bridges and viaducts spanning valleys in Europe. Lead into lesson with reasons for why students must know how to build arches.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	**TECHNICAL CONCEPTS**	**SCIENCE**
A. Definition of an arch.	1. Any curved structure made of a number of pieces which spans an opening. 2. A structure supported by its ends and formed of a number of distinct pieces--no one of which spans the opening. a. Downward thrust is transferred to the ends of the arch b. Downward thrust is transferred to lateral thrust	
B. Principle of corbel.	1. A principle of structural weight distribution, involving masonry units, whereby an opening may be spanned by utilizing a cantilever effect of individual units extending approximately one half their length, over the opening from the piers on successive courses. a. Corbelled arches were used on the viaduct leading to palace of Knossos b. Frequently, the top stone in a corbelled arch was of longer length than most units.	1. Develop the concept of cantilever. a. As it applies to beams b. Relate to the corbelled arch
C. Types of arches.	1. Flat arch or jack arch. a. Is a true arch although a weak one b. Usually arch members are supported by a structural member 2. Segmental arches. a. The strongest type of arch when abutment is strong 1) Proportion should be--rise equals one-eighth of the span b. Is a segment of a circle 3. Relieved segmental arch. a. Arch design (curved aspect) is same as plain segmental arch b. Incorporates a lintel c. Core area or area between top of lintel and bottom of arch is filled in with masonry d. Helps relieve load on pier 4. Semicircular arch. a. Arch is one-half of a true circle b. Is quite strong on small spans c. Height above centerline tends to limit its use	1. Present principles of arches. a. Have students construct various types of arches and subject them to loading tests 2. Principle of the keystone. a. Why used b. Forces acting upon the keystone

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Develop vocabulary relating to arches. a. Corbel b. Cantilever c. Pier d. Abutment e. Camber f. Jamb	1. Discuss the Great Wall of China and make reference to the need for arches or post and beam construction at the gates. a. Construction of wall b. Influence on history
	1. Read and write composition about a structure utilizing arches.	1. Structures using the corbelled arch. a. The viaduct leading to the Palace of Knossos b. Inca Temples
1. Basic geometric construction related to arch layout. a. Erecting perpendiculars b. Bisecting lines c. Lay out and striking arcs 2. Geometric construction of the Gothic arch.	1. Develop vocabulary relating to arches. a. Span b. Rise c. Extrados line d. Intrados line e. Key f. Crown g. Spandrel h. Springer i. Springing point j. Skewback k. Soffit	

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	5. Gothic or pointed arch. a. Reasonable strength b. Uses largely limited to churches and public buildings 1) Aesthetic aspects 6. Inverted arch. a. Usually an inverted segmental arch b. Function is to spread load from a pier to a greater area of the footing	
D. Laying out arches.	1. Flat arches are generally layed out from a radial point. a. Strike a radius equal to the width of the opening from the spring point to where it intersects a vertical centerline of the opening. This point of intersection becomes the center point for the radial lines. b. A radial line from the established centerline to each spring point is struck c. Lay out center or key brick d. Compute number of bricks required to fill area from the edge of the key brick to the edge of the skewback bricks 2. Segmental arches. a. Establish the span of the arch b. Erect a vertical centerline of the span c. From a horizontal line extending from springing point to springing point, measure, on the vertical centerline, the rise of the arch. The rise is frequently 1/8 of the span d. Using one spring point as a center and the center established by measuring the rise on the centerline, strike arcs, the radius being one-half the span, from these centers e. A line drawn through the intersections of these arcs to a point of intersection on the vertical centerline will establish the center for the segment f. Using the established center and a radius from the center to a springing point, strike the arc of the segment	1. Exercises and tests in the loading of beams and arches.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Develop concept of radial lines. 2. Division problems to find number of bricks required to fill a given lineal distance. 3. Practice problems in laying out segmental and circular arches.		1. Technological advances, particularly in steel and concrete construction which influence arch construction. a. Steel strength b. Concrete as a plastic material c. Form construction 2. Historical study of the Colosseum. a. Roman culture b. Uses of the Colosseum c. Circular structure d. Semicircular arches e. Construction methods

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
	3. Semicircular arch. a. Establish the span of the arch b. Establish vertical centerline through the span of the arch c. Establish horizontal centerline from springing point to springing point d. Using half the span as a radius and the cross point of the center lines as center, scribe the required arc	
E. Temporary supports.	1. For all arches except the flat and inverted arches, a temporary support must be constructed. a. Support layout is developed as per previous section b. Support must be accurately constructed c. Support must be strong enough to hold total load until mortar hardens 2. Construction of supports. a. Select good lumber which is free of knots which would weaken it. b. No single structural configuration is used; but, consideration must be given to 1) Good support at jambs 2) Sound structure to support segment or semicircular shape 3) Maintenance of levelness through thickness of wall 4) Ease of form removal	1. Discuss forces and use of diagonal braces and other structural configurations for providing strength and rigidity.
F. Laying bricks.	1. Principle--each member of the arch structure particularly soldier courses, should be radially shaped wedges. a. Mortar joints should be uniform width b. Masonry unit ends must be properly cut 2. Cutting or rubbing bricks to wedge shape. a. Establish dimensions of wedge b. Cut large amounts first c. Rub brick to final dimension 3. Masonry units must be properly bedded in mortar and all joints must be full. 4. Supports must remain in place until mortar has hardened.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Reading blueprints and specifications for understanding and gathering information required to lay out arches. 2. Reading instructions relating to arch layout.	
1. Laying out bricks for cutting and rubbing to shape bricks to a radial wedge.		1. Study of the historical-technological influence of a. Column and beam construction b. Barrel vault con- tion

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
G. Removing forms.	1. Precautions. a. Even though mortar is hard, it is still green and will not withstand much prying pressure b. When drawing nails be sure excessive force is not applied to masonry c. Observe safety as it applies to loose members falling and maintenance of worker balance on scaffolds	1. Review of principles of levers as they apply to a. Pulling nails b. Prying supports

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Present basic principles of arch construction.

B. Use slides, transparencies, and models to demonstrate types of arches.

C. Practical application laying various types of arches up to springing point.

D. Practical application building arch form.

E. Practical application shaping and laying arch masonry units.

F. Summary and evaluation.

IV. EVALUATION CRITERIA GUIDELINE

A. List and describe four types of arches.

B. Explain how forces are directed to pier areas by the arch structure.

C. Sketch a suitable support form structure for a semicircular arch.

D. Demonstrate ability to lay out a segmental arch to given dimensions.

E. List various uses for arches.

F. Explain and demonstrate how to rub bricks to a wedge shape.

V. SUMMARY

A. Buildings and structures must have doors, windows, and other openings in the walls. The masonry above these openings must be supported in some manner. Arches are employed to do this and various types of arches also enable adding decorative features to the structures. Therefore, the mason must know how to form and lay bricks for various types of arches.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Principles of arch construction, nomenclature, demonstration on layout of arches

90 minutes -- Integrated curriculum concepts

INSTRUCTOR'S UNIT PLAN

Unit 17
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Cleaning, Treating, and Painting Masonry Work

AIM:

To teach how to clean masonry work, including brick and stone. Also, to teach how to select and use masonry coating products.

INSTRUCTIONAL AIDS:

Slides - Teacher-made, showing mortar, stains, and efflorescence.

Samples - Brushes, acids, soaps, detergents used for cleaning masonry.

EQUIPMENT:

Fiber bristle brushes, rubber gloves, eye protection goggles, rubber pails, muriatic acid, detergents, and white sand.

Selected silicon paints, oil paints, concrete paints, and appropriate brushes.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 2, Chicago: American Technical Society, 1971.

2) Structural Clay Products Institute, Bricklaying II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

3) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Show slides with examples of poor mortar work, stains, etc. and elicit comments about how they detract from the appearance of a finished building. Point out that the appearance of the building is as important as its structural soundness since both were initially planned. Lead into the lesson with questions about how masonry can be cleaned.

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Need for cleaning.	1. Poor trowel work frequently leaves unsightly mortar smears around mortar joints and this must be removed to provide a satisfactory appearance to the bricks. 2. Mineral stains from mortars or other foreign sources must be removed so they are not unsightly. 3. Efflorescent stains must be removed since they indicate moisture and chemicals in the wall. The source of moisture in the wall must be removed or else the efflorescence will recur.	1. Explanation of the various minerals involved in mortar, sand, lime, which may stain masonry. a. Mineral inclusions in materials used b. Foreign minerals from tools, nails, etc.
B. Removing mortar stains from bricks.	1. Best policy is for mason not to get mortar on face of bricks. 2. Mortar on face should be brushed off when joints are struck or after surface has slightly dried. 3. After mortar has hardened, bricks should be brushed again. 4. Wash bricks with 10% muratic acid solution and stiff-bristled fiber brush. a. Mason should wear protective clothing, rubber gloves, and goggles b. Check acid on bricks to see that it does not cause discoloration c. Flush cleaned bricks with clean water. Be sure all acid is removed	1. The chemical reaction that enables muratic acid solution to clean mortar from bricks. 2. Safety in mixing acid and water--general safety relating to acids and bases. 3. Mixing various acid solutions by weight and volume.
C. Cleaning glass block panels.	1. Place mortar carefully. 2. After joints are struck or jointed, wipe with a clean, dry cloth. 3. Further clean with 10% muratic acid solution, if necessary.	
D. Removing stains from stone.	1. Most building stones are of some type limestone. 2. Usually stones are cleaned when final pointing is done. 3. Usually hand brushing with a stiff brush and detergent scouring powder are used.	1. Oxidation (rusting) of steel or iron which causes discoloration.

TO BE DEVELOPED

MATH	*COMMUNICATIONS*	*SOCIAL STUDIES*
	1. Develop vocabulary relating to stains, etc. on masonry. a. Mineral stains b. Efflorescence c. Muratic acid d. Sodium hydrosulphite e. Oxalic acid f. Ammonium chloride g. Sodium citrate h. Etc.	
1. Problems dealing with proportions and percentages when mixing solutions. a. By weight b. By volume	1. Write report on safety precautions necessary when working with acids.	1. Safety regulations concerning working with acids, bases, and other dangerous compounds.
		1. Discuss modern building materials and their impact on present day structures. a. Glass blocks b. Precast masonry panels c. Tilt-up construction
1. Computation of quantities of materials required to clean a given area.		

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	a. Use fiber brush--steel wire brushes often leave pieces of steel which cause rust b. May scour with white sand 4. Acids are rarely used since they may cause spotting and discoloration. 5. Large areas are sometimes steam cleaned.	
E. General stain removal.	1. Iron stains. a. Mop or scrub area with one pound oxalic acid to one gallon of water 1) Reapply if necessary 2) Thoroughly wash area b. Difficult stains may be removed with one part sodium nitrate to one part glycerin, thickened with whiting 1) Apply as paste 2) Permit to dry 3) Remove with water c. Sodium hydrosulphite can be used to remove very dark iron stains 1) Soak surface with one part sodium citrate with six parts water 2) Cover soaked area with thin layer of hydrosulphite crystals 3) Wash thoroughly with water when stain is removed 2. Copper, bronze stains. a. One part ammonium chloride, one part talc and water to form paste 1) Apply to stain and let dry 2) Remove, flush with water b. Aluminum chloride in the same proportions can also be used 3. Aluminum stains. a. Can be removed with a 10 to 20% muratic acid solution 4. Smoke and fire stains. a. Scour area with detergent, pumice powder, or scouring powder b. Apply poultice of detergent and scouring powder	1. Stain removing qualities of: a. Oxalic acid b. Sodium nitrate c. Sodium citrate d. Hydrosulphite crystals

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computation of time estimates for cleaning walls.	1. Writing for information on commercially prepared stain removers. a. Research masonry suppliers' catalogs b. Research McRae's Catalogs c. Research Thomas' Register	1. Environmental pollution affecting buildings. a. Smoke sulfur corrosion of buildings b. Stains from air-carried minerals

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
F. Painting.	1. Interior dry above grade masonry walls may be painted by applying: a. Cement-water paints b. Resin-emulsion paints c. Oil-based paints d. Rubber-base paints e. Follow directions on packaging 2. Exterior walls. a. Cement-water paints 1) Clean all dust and dirt from surfaces 2) Dampen wall one-half hour before applying paint 3) Mix paint thoroughly 4) Apply by brushing into all crevices and openings with a stiff-bristled brush 5) Apply two coats with 24 hrs. between coats 6) After second coat has dried for 6-8 hrs. wet surface with fine water spray b. Rubber-base paint 1) Clean surface thoroughly 2) Thin first coat or follow manufacturer's directions 3) Spray or brush onto surface 4) Apply second coat when first has dried 3. Exterior colorless waterproofing paints. a. Wall must be well-cleaned b. Wall should be dry c. Silicon or other plastic resin materials are used 1) Should be applied according to manufacturer's directions d. Sometimes used to seal wall after efflorescence has been removed	1. Composition of cement-water paints 2. Composition of rubber-base paint.
G. Efflorescence.	1. Usually caused by leak in wall or excessive surface wetting. a. Best controlled by preventive measures 1) Check rain gutter leaks 2) Check masonry cracks 3) Coat surface with clear waterproofing material	1. Cause of efflorescence--chemical reaction of salts.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computation of area to be painted. a. One coat jobs b. Two coat jobs c. Multiple coat areas	1. Writing for specifications and instructions on various commercial paints.	1. Discussion of "fast buck" schemes for home maintenance. a. Waterproofing materials b. Concrete paints c. Roofing materials d. Driveway sealers

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
	2. Removing efflorescence. a. Use one part muratic acid to 6-10 parts water b. Scrub areas, avoiding mortar joints--use stiff fiber brush 1) Use protective goggles, gloves, etc. c. Wash area thoroughly with water	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Introduce lesson and generate interest.

B. Present methods of removing stains--demonstration.

C. Integrated curriculum concepts with emphasis on the science aspects.

D. Practical application on removing stains on existing buildings or newly constructed walls--painting walls.

E. Integrated curriculum concepts.

F. Summary and evaluation.

IV. EVALUATION CRITERIA GUIDELINE

A. What paints may be effectively used on exterior walls?

B. How may mortar stains be removed from bricks?

C. What is efflorescence? What causes it?

D. How may efflorescent stains be removed from brick walls?

E. How may iron stains be removed from masonry?

F. How do you mix acid and water?

G. What safety precautions should you exercise when working with acids?

V. SUMMARY

A. The most carefully laid masonry wall can be made unsightly by mortar stains, mineral stains, or other surface stains which detract from its appearance. Therefore, the mason should know correct stain removal practices which will not weaken the masonry structure. Also, the mason should know what paints to select to paint surfaces to ensure a quality job.

VI. SUGGESTED TIME AND SEQUENCE LISTING

20 minutes -- Introduction and motivation

60 minutes -- Presenting methods of stain removal

60 minutes -- Integrated curriculum concepts--science

140 minutes -- Practical application--stain removal and painting

60 minutes -- Integrated curriculum concepts

20 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Jones, David Thomas, Face Brickwork, Scranton, Pa.: International Correspondence Schools, 1960.

2) Kuhfeld, Harold, Advanced Bricklaying, Albany, N. Y.: Delmar Publishers, Inc., 1960.

3) Mulligan, John A., Handbook of Brick Masonry Construction, New York: McGraw-Hill Book Company, 1942.

INSTRUCTOR'S UNIT PLAN

Unit 18
Lesson 1
Time 6 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Constructing Chimneys

AIM:

To teach correct configuration and methods of laying brick, block, and flue liners for chimneys.

INSTRUCTIONAL AIDS:

Transparencies - Teacher-made, of various chimney configurations showing single flue, double flue, rectangular, square, and round construction.

Slides - Teacher-made, of terra cotta or clay tile flues, concrete masonry chimney blocks, and other flue lining mediums.

Slides - Classification and Manufacture of Structural Clay Products, McLean, Virginia: Structural Clay Products Institute, 1750 Old Meadow Road (30 slides, 35 mm).

EQUIPMENT:

Overhead projector, 35 mm slide projector, screen.

Samples of: flue liners, concrete masonry chimney blocks, other liner mediums

Tools: square, level, blocking chisel, trowel, plumb bob.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 1, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 2, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying II, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Most homes are heated with some type of petroleum or coal and consequently a chimney becomes a necessity. Lead discussion into the requirements of an effective chimney from the points of structure, function, and safety. Lead into the technical aspects of chimney construction. Use selected slides and transparencies to introduce material.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	***TECHNICAL CONCEPTS***	***SCIENCE***
A. Foundations	1. Foundation must be strong enough to support the load imposed upon it. a. Weight of masonry b. Weight concentrated on small area c. Reinforcement needed	
B. Principles related to draft.	1. Free unobstructed flue chamber. 2. Adequate height to produce air column. 3. Adequate height above ridge of roof. a. 1'-0" minimum b. Federal Housing Authority requires 2'-0" minimum 4. Offsets in flues. a. Maximum offset is 30° from vertical b. Greater offset interferes with air movement and permits soot accumulation	1. Expansion and contraction of a gas. 2. Principles of convection. a. Hot air rises--is lighter b. Cold air is heavier 3. Principles of heat transfer by: a. Radiation b. Conduction c. Convection
C. Layout of masonry units.	1. Layout of masonry units at foundation level. a. To accept flue liners b. Single flue chimney c. Double flue chimney d. Layout of brick to enable correct bond 2. Laying bricks up to flue clean-out door level. a. Solid base foundation b. Poured concrete floor at clean-out level with proper slope	1. Temperature measuring scales. a. Fahrenheit b. Centigrade c. Kelvin d. Rankine e. Calorie f. British Thermal Units
D. Setting flue liners.	1. Establish starting point for flue liners. a. Usually one unit below entry point of crock or thimble from furnace 2. Setting headers to support flue liners. a. Extension of header into flue cavity--approx. 1" into the cavity to hold flue liner b. Set or lay other courses to properly set and bond headers	1. Flash or kindling points of various construction materials.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computation of weight of masonry involved in a chimney. a. Weight per sq.ft. b. Weight by volume c. Weight of materials 2. Area bearing on footing. a. Needed or required footing size b. Needed thickness		1. Study of various heating systems. a. Fossil fuels b. Petroleum c. Electric 2. Conservation aspects. 3. Economics of various heating systems.
1. Changing Fahrenheit reading to centigrade. 2. Changing centigrade reading to Fahrenheit. 3. Computation of expansion of gases.	1. Development of vocabulary. a. Draft b. Flue c. Offset d. Chimney pots	
1. Math problems involving: a. Calories b. British Thermal Units		1. Historical studies involving: a. British Thermal Units b. James Watt c. Joseph Black
	1. Developing ability to take notes. a. Outlining procedures b. Identifying pertinent and important material or information	

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
E. Proper bedding, bonding, and sealing masonry units.	1. Bricks must be properly bedded and laid true and plumb. 2. Flue liners must be carefully set in mortar to assure tight joint between flue sections. 3. When bricks are laid around the flue liner, the area between liner and bricks must be slushed full of mortar. 4. Opening for thimble or entry crock must be carefully cut and properly bedded in mortar.	1. Fire safety as it relates to hot spots as a result of mortar voids in flue and brick chimneys.
F. Finishing the chimney--chimney cap.	1. Cement mortar cap. a. Sand and cement mortar cap b. Slopes out from flues 2. Solid stone caps--rarely used but provides a good waterproof cap. 3. Covered flues prevent rain from entering flues. a. Openings must be adequate size b. Prevailing wind must be considered	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Introduce material. Have students lay out bricks for a single flue chimney and lay bricks for same--setting clean-out door, flues, and finishing top.

B. Have students do same as above for two-flue chimney.

C. Have students lay chimney with an offset flue; cut flue liner for correct bevel.

D. Cut opening for thimble in flue liner.

IV. EVALUATION CRITERIA GUIDELINE

A. Why must the foundation be heavier than for the rest of the building?

B. Why must the chimney be tight so that there are no air leaks?

C. What function does the chimney cap serve?

D. Change 91°F. to the correct centigrade reading.

E. Why must the chimney extend above the ridge of the roof?

V. SUMMARY

A. Chimneys are an important part of most buildings and a mason must know how to properly construct a chimney so that it is structurally and functionally sound. He must ascertain that the foundation will support the weight of the chimney and also build in proper supports through attic areas or other areas requiring support.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- Demonstrate various layouts for single, double, and round flues

150 minutes -- Practical application with single flue chimney

90 minutes -- Integrated curriculum concepts

180 minutes -- Practical application building double flue chimney

180 minutes -- Practical application building chimney with offset flue

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Nash, William G., Brickwork One, San Francisco: Drake Publications, 1971.

2) Ray, Jesse E., The Art of Bricklaying, Peoria, Ill.: Charles A. Bennett Company, Inc., 1971, 3rd Edition.

INSTRUCTOR'S UNIT PLAN

Unit 19
Lesson 1
Time 12 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Constructing Foundations, Trimmer Arches, and Hearths for Fireplaces

AIM:

To teach correct procedures for constructing the foundation, trimmer arch, and hearth for fireplaces.

INSTRUCTIONAL AIDS:

Transparencies - Teacher-made, of foundation structure, ash pit floor, clean-out door, trimmer arch, interior hearth, and ash drop.

Slides - Teacher-made, of attractive finished fireplaces showing floor level and raised hearths.

EQUIPMENT:

Overhead projector, 35 mm slide projector, screen.

8" concrete block, clean-out door, ash drop door, lumber to construct trimmer form, concrete, hearth bricks, mortar.

Trowel, level, brick hammer, block hammer, blocking chisel, handsaws, claw hammer, and nails.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 2, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 2, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying III, Albany, N.Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Open discussion with questions concerning how the hearth is supported. Use responses to lead into showing of transparencies on foundation construction. Continue with lesson.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Fireplace foundations.	1. Principles involved: a. Footings must be sized so as to support the masonry weight of fireplaces and chimneys b. Foundation must be sized so as to be equal in size to the overall outside finish dimensions of the fireplace or fireplaces it supports 2. Footing is generally poured as a slab to distribute weight over the maximum area. 3. Footings are frequently reinforced with steel. 4. Frequently, oil furnace flues are incorporated in foundation.	1. Principles of combustion: a. Fuel b. Oxygen c. Kindling temperature
B. Ash pit floor.	1. Height above basement floor should be high enough for comfortable removal of ashes. 2. Should slope on back and sides to funnel ashes to area directly in front of clean-out door. 3. Ash pit floor should be relatively smooth.	1. Uses of ashes by early settlers for potash, lye, and soap. a. Understanding of the leaching process
C. Clean-out door.	1. Preferably cast iron but pressed steel is used. 2. Various sizes are available a. 10" x 10" common b. 8" x 8" also used 3. Door must be carefully bedded in mortar to prevent loosening.	1. Review of galvanic action of metal-to-metal and other reactions between metal and mortars.
D. Trimmer arch construction.	1. Trimmer and header framed opening in floor structure. 2. Forming for trimmer arch. a. Nailing ledgers b. Making forms 1) Some arches are actually curved 2) Most present day arches are actually straight on bottom 3) Form material must be thick enough to support weight of concrete without sagging c. Building arch of corbeled masonry	1. Effect of heat on portland cement and also on mortar cement. 2. Need for fireclay mortar. a. Firebricks b. Fireclay mortar

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computation of bearing area of footing--load bearing quality of soil versus bearing area. 2. Compute total weight of fireplace structure.	1. Nomenclature of foundation unit--developing vocabulary. a. Ash pit b. Trimmer arch c. Header d. Trimmer e. Ash dump	1. Historical studies about methods man has used to heat his dwellings prior to the fireplace.
1. Geometry useful in forming or planning sloping sides of ash pit floor.		1. Development of the flue or chimney.
	1. Writing for catalogs and other information concerning dampers, clean-out doors, ash dumps, etc.	1. Studies of methods man has used to prepare his food. 2. Study of colonial fireplaces and materials used for cooking devices.
1. Computing material and slope for trimmer arch with flat bottom. 2. Layout of curved forming members.	1. Reading Federal Housing Administration small building regulations concerning fire prevention around fireplace structures. a. Minimum masonry thicknesses b. Air space clearance c. Fireproofing materials	

RELATED CONCEPT

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	3. Size of trimmer arch. a. Equal to required exterior hearth size b. Should extend from face of fireplace legs a minimum of 16" 4. Use of reinforcing steel may be necessary to attain adequate strength. 5. Interior hearth cap is frequently poured at same time as trimmer arch. a. Forming is placed on ledgers nailed to interior of ash pit opening b. Form pan is placed on ledger c. Ash dump opening is formed 6. Interior hearth and trimmer arch should be a minimum of 4" thick, 6" preferred. 7. Interior hearth must be formed so that face brick or stone can be laid to floor level.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Introduction and motivation.

B. Compute foundation area, size, and thickness.

C. Demonstrate layout of foundation and have students lay up foundation and place clean-out door. Make provisions for furnace flue.

D. Practical application--forming for trimmer arch.

E. Lay out on practice floor the interior and exterior fireplace hearth and set hearth firebricks.

IV. EVALUATION CRITERIA GUIDELINE

A. Explain how to determine the size of the fireplace foundation.

B. What considerations must be given to location of the clean-out door?

C. How is the ash pit floor designed?

D. Explain how to form a trimmer arch.

E. What is firebrick? Fireclay? How is fireclay mortar mixed?

V. SUMMARY

A. The foundation of a fireplace is very important in that it must support considerable weight. Also, the size of the foundation controls the size of the total fireplace structure and hence must be accurate in size. Ash clean-out doors, soot clean-outs, furnace thimbles, and flues must be correctly placed so that they function correctly and safely. The mason must thoroughly understand fireplace foundation construction to enable correct construction.

VI. SUGGESTED TIME AND SEQUENCE LISTING

15 minutes -- Introduction and motivation

45 minutes -- Use transparencies to present fireplace structure

120 minutes -- Integrated curriculum concepts

240 minutes -- Practical application--lay out and lay up foundation

120 minutes -- Form trimmer arch

150 minutes -- Lay out interior and exterior hearths on practice floor. Lay firebricks for hearth

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Atkinson, Henry F., Rough Carpentry and Masonry, New York: McGraw-Hill Book Company, 1969.

2) Frost, William and Boughton, R. V., Modern Practical Brickwork, London: Batsford Publishers, Ltd., 1954.

3) Kuhfeld, Harold, Advanced Bricklaying, Albany, N. Y.: Delmar Publishers, 1960.

INSTRUCTOR'S UNIT PLAN

Unit	20
Lesson	1
Time	12 Hours

CLUSTER: CONSTRUCTION

DIVISION: MASONRY WORK

SUBJECT: Fireplace Work

AIM:

To teach students how to lay fireplaces, set dampers, lintels, flue liners, and hearths.

INSTRUCTIONAL AIDS:

Transparencies - Teacher-made, of interior hearth, hearth, back firebrick wall section, plan section, lintel section, and smoke chamber.

Slides - Teacher-made, of fireplaces at various stages of completion showing all pertinent nomenclature.

EQUIPMENT:

Overhead projector, 35 mm slide projector, screen.

Firebrick, fireclay mortar, mortar face bricks, damper, flue liners, lintels, trowel, brick hammer, blocking chisel, and level.

PRIMARY REFERENCES:

1) Dalzell, Ralph and Townsend, Gilbert, Masonry Simplified, Volume 2, Chicago: American Technical Society, 1971.

2) Graham, Frank D., Masons and Builders Guide, Volume 2, Indianapolis: Theodore Audel, 1970.

3) Structural Clay Products Institute, Bricklaying III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

4) Structural Clay Products Institute, Teacher's Manual and Answer Book, Bricklaying I, II, III, Albany, N. Y.: Delmar Publishers, Inc., 1952.

I. INTRODUCTION AND MOTIVATION

A. Request ideas relative to how well fireplaces served as a means of heating a room. Discuss reasons why homeowners would want fireplaces in their homes. Show slides and transparencies of fireplaces and lead into the lesson.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
A. Functions of a fireplace.	1. Rarely one of providing heat; however, some prefabricated fireplaces serve this function. 2. Creating mood. a. Feeling of warmth b. Feeling of comfort c. Atmosphere of closeness d. Atmosphere of informality 3. Aesthetics. a. Frequently is the central theme in a room b. Changes general texture in a room c. Mood or attitude created can be aesthetic	
B. Theory of fireplaces.	1. Warming effect. a. Principle applied is that of radiant heat b. Very little circulation of heat or convection currents 2. Principles of combustion and chimney action which remove air (oxygen) and hence heat from a room. a. Materials necessary for combustion b. Heated air rises 1) Lighter c. Cool air falls 1) Heavier d. Air to supply oxygen must come from room 3. Design principles--fireplaces must be constructed so as to provide proper proportions to enable proper combustion and efficient removal of smoke. a. Opening height b. Opening width c. Fireplace depth d. Smoke shelf design e. Flue size f. Damper size and control	1. Review concepts of heat transmission: a. Radiant b. Convection c. Conduction 2. Properties of gases. 3. Principle of fireplace chimney design to prevent smoking. a. No smoke shelf 1) Effect of downdraft in chimney b. Smoke shelf 1) Control and redirection of downdraft in chimney
C. Laying the interior hearth.	1. Bedding firebrick in fireclay a. Mix clay the day before b. Spread stiff clay uniformly over hearth c. Set bricks and tap into place d. Carefully point all joints full 2. Place ash dump while laying hearth and bond it as an integral unit.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Mathematical proportions. 2. The Golden Rectangle--design aspects of proportions of this rectangle.	1. Develop vocabulary dealing with fireplaces. a. Flue b. Mantle c. Lintel d. Damper e. Smoke shelf f. Jambs or legs g. Corbel h. Facing	1. The contributions of Benjamin Thompson, better known as Count Rumford, to fireplace design. a. Loading and firing British cannons b. Boring cannons for Bavaria c. Interest in heat d. Smoke shelf concept
	1. Read about Count Rumford--give oral reports about his many contributions.	1. Early taxes on chimneys and hearths. a. Fummage tax (smoke) b. 1662 English Hearth Tax Law 2. Importance of fireplaces in Colonial America. a. Fireplaces in New England b. Fireplaces in the South c. Fireplaces and Abraham Lincoln
1. Geometry or angular layout necessary for laying out innerfireplace shape. 2. Angular measurement necessary to slope sides and back of fireplace.		

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
D. Interior fireplace work.	1. Establish correct proportions for fireplace. a. Usually are included on working drawings b. FHA sets minimum standards on homes it insures c. Proportions and dimensions are available in a number of texts d. Damper manuals and catalogs include dimensions 2. Lay out shape of fireplace, first course, firebricks dry. a. After shape is established properly bond and slush each course b. Allow air space at back and sloped walls for expansion 3. Lay up firebrick to height approx. 8" above front opening. a. Set damper b. Lay up approx. 3 courses of brick for rear of smoke shelf 1) Must be plumb 2) Smoke shelf area must be smooth c. Set throat lintel d. Corbel front of fireplace throat back to depth required to set flue--not over 30° slope 1) Lay offset or ledger bricks to support flues 2) Ledger bricks should not extend more than 3/8" beyond interior of the flue liner	
E. Face work on fireplaces.	1. Lay up jambs or legs to opening height. a. Best policy is to build the jamb along with interior b. Jambs must be carefully laid, pointed, and cleaned 2. Setting opening lintel. a. Lintel should extend onto jamb at least 6" b. Lintel must be sized to prevent sagging--1/4" to 1/2" by 3" x 4-1/2" will serve openings up to 4'-0" in width 3. Lay face work over lintel.	1. Coefficients of expansion of various face work material.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Read and interpret literature from various damper and fireplace suppliers. a. Read to enable making of a selection b. Write purchase orders for selected dampers, lintels, etc.	1. Review controls of Federal Housing Administration relative to: a. Fireplace design b. Fire safety considerations c. Watershed or water tightness around chimneys
	1. Read some poems which utilize the fireplace as a main or subordinate theme.	1. Ecological aspects of fireplaces. a. Air pollution b. Burning trees c. Chemical colorants

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	*TECHNICAL CONCEPTS*	*SCIENCE*
	4. If a masonry mantel is used, set mantle at proper height. 5. Complete face work masonry. 6. Face work may be of many materials and each must be properly set. a. Stone b. Brick c. Marble d. Glass	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Introduction and motivation.

B. It is virtually impossible to teach how to lay a fireplace by words. Therefore, after the basic nomenclature is taught, the lesson should be totally one of demonstration and practical application. Have teams of students lay up fireplaces of various sizes and with various face treatments.

C. Integrated curriculum material should be presented during periods when it is necessary to permit mortar to set somewhat.

IV. EVALUATION CRITERIA GUIDELINE

A. Why must fireclay mortar be used for fireplaces?

B. What is the correct shape of a fireplace throat? Why is it so shaped?

C. Why must accurate proportioned dimensions be used for fireplace height, width, depth, etc.?

D. Of what material are fireplace dampers made?

E. How is a room heated by a fireplace?

V. SUMMARY

A. Fireplace work is exact, demanding work. The fireplace must function. It must permit a fire to burn without having the smoke enter the room. Therefore, since it usually cannot be tried until the house is completed, it is necessary that it be properly proportioned and constructed. Students should learn how to properly build fireplaces.

VI. SUGGESTED TIME AND SEQUENCE LISTING

30 minutes -- Introduction and motivation

60 minutes -- General discussion and presentation of nomenclature

180 minutes -- Integrated curriculum concepts

420 minutes -- Demonstration and practical application

30 minutes -- Summary and evaluation

VII. SUPPLEMENTAL REFERENCES AND RESOURCE MATERIAL

1) Atkinson, Henry F., Rough Carpentry and Masonry, New York: McGraw-Hill Book Company, 1969.

2) Kuhfeld, Harold, Advanced Bricklaying, Albany, N. Y.: Delmar Publishers, Inc., 1960.

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Bricklayer, Toronto: Guidance Center, University of Toronto, 1955.

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De Cristoforo, R. J., Concrete and Masonry Ideas for the Home-Owner, Greenwich, Conn.: Fawcett Publications, Inc., 1962.

De Cristoforo, R. J., Handyman's Concrete and Masonry Handbook, New York: Arco Publishing Company, Inc., 1960.

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Graham, Frank D., Masons' and Builders' Guide: Plastering, Volume 4, Indianapolis: Theodore Audel, 1958-59.

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